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Bituminous Coal Research, Inc.
Monroeville, PA

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COAL AND THE ENVIRONMENT ABSTRACT SERIES

Bibliography on Disposal of Mine and Cleaning Plant Refuse

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This volume is the fifth to appear in the "Coal and the Environment Abstract Series" and is an updated edition of the "Bibliography on Disposal of Mine and Clean Plant Refuse". Other volumes in the series are "Reclamation of Coal Mined Land" and "Mine Drainage Bibliography". The three bibliographies in the series are intended to complement one another. While each covers on particular subject areas, inevitably some documents listed in one are also relevant to one of the other bibliographies. In addition to the abstracts, this volume includes an Author Index and a General Index.

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FOREWORD

When energy and material resources are extracted, processed, converted and used, the related pollutional impacts on our environment and even our health often require that new and increasingly more efficient pollution control methods are used. The Industrial Environmental Research Laboratory - Cincinnati (IERL-Ci) assists in developing and demonstrating new and improved methodologies that will meet those needs both efficiently and economically.

This publication is the fifth of the "Coal and the Environment Abstract" series. It provides the researcher, scientist, mine executive, and regulator with a timely bibliography. Not only will it provide the research community with a means of readily accessing the literature, but it should provide those persons disposing of mining and cleaning plant refuse with a handy reference to solving their problems.

David G. Stephan
Director
Industrial Environmental Research Laboratory
Cincinnati

PREFACE

Coal is our most plentiful source of energy, and its use is essential to the well-being of the nation. As coal continues to be produced and as mines are opened in areas where mining has not existed previously, opportunities for the occurrence of environmental degradation will increase. However, such degradation need not occur if the existing and evolving pollution control technology is well known and properly applied.

Numerous public and private efforts have contributed to the knowledge concerning coal's environmental problems and to their control. This knowledge is well documented, and the U.S. Environmental Protection Agency (EPA) has been actively involved in compiling and disseminating it. One facet of this activity has been the co-sponsorship of a comprehensive coal-environment library at Bituminous Coal Research, Inc. (BCR) for use by the public as well as the coal industry, and the publication of Bibliographies of abstracts based on the collections within the library.

This Bibliography on Disposal of Mine and Cleaning Plant Refuse is the fifth to appear in the "Coal and the Environment Abstract Series." It contains almost 300 newly listed references, plus all references and abstracts found in the initial coal-refuse disposal Bibliography published in 1978, a total of nearly 800 references. Preparation of this edition was co-sponsored by EPA, Department of Interior's Office of Surface Mining Reclamation and Enforcement (OSM), and BCR.

The other volumes in the series are "Bibliography on Mined-Land Reclamation," "Mine Drainage Bibliography 1910-1976," and "Mine Drainage Bibliography 1929-1980." The first Bibliography in the series, "Mine Drainage Abstracts 1910-1976," based on an information project carried out by BCR since 1961, was prepared in 1976 by BCR with co-sponsorship of the Pennsylvania Department of Environmental Resources and EPA. Copies of that bibliography may be obtained by requesting it by name from BCR or by number PB-265 041/4BE from National Technical Information Service (NTIS), prepaid. "Mine Drainage Bibliography 1929-1980," EPA-600/7-80/113, which updates the earlier volume, is also available from BCR by name and from NTIS, prepaid, by number PB80-221062. The Reclamation Bibliography, EPA-600/7-79-102, can be obtained from BCR and from NTIS as PB-298 191/8WP. The addresses are given at the end of the preface.

The Bibliographies in the "Coal and Environment Abstract Series" are intended to complement one another. While each covers one particular subject area, inevitably some documents listed in one are also relevant to one of the other Bibliographies. For example, the Reclamation Bibliography includes information on the effects of surface mining and reclamation on hydrology and, to some extent, on water quality. However, most of the information on changes in water quality resulting from surface mining and reclamation has been listed in the Mine Drainage Bibliography. Another example of overlap is in the assignment of documents concerned with overburden or spoil. In American usage, these terms are synonymous but in British usage, the term "spoil" includes both overburden and refuse from coal mining and coal cleaning plants. Documents on "spoils" have been separated into those relating to refuse and to overburden and put in the proper Bibliography. Since a number of British documents give information on both kinds of "spoils," the reader should probably scan both the Reclmation Abstracts and the Refuse Disposal Abstracts. Finally, many documents include material on each of the subject areas covered by the Bibliographies. If one subject area has been emphasized more than the other two, the document is listed only in the bibliography relating to that major area. However, it is indexed in that Bibliography to show that it also contains information relating to other subjects. If there are major emphases on more than one area, the document is listed in each of the Bibliographies to which it is relevant.

The subjects covered in this bibliography include the analysis and characterization of coal refuse; various methods of handling, storing, and disposing of coal refuse; environmental problems such as refuse drainage quality and combustion of refuse piles; the control of environmental problems; uses for refuse; and reclamation of refuse disposal areas. The coal cleaning process itself is very closely related to the general subject area covered in this bibliography. However, publications on coal cleaning have not been included unless they contained information that contributed significantly to the knowledge and understanding of coal refuse and its related disposal problems.

In addition to the abstracts, this volume includes an Author Index and a General Index. These are described in the section, "Format and Use of the Bibliography." The Appendixes provide lists of the publications most recently acquired for the other volumes of "Coal and the Environment Abstract Series." Appendix A continues the update for "Bibliography on Mined-Land Reclamation" which was begun in the previous volume in this Series. Appendix B gives an update for that previous volume, "Mine Drainage Bibliography 1929-1980."

Much of the literature listed in the "Coal and the Environment Abstract Series" is available from large libraries, government agencies issuing particular reports, or from the authors. Complete citations have been given so that the reader can obtain material from these sources. Items with NTIS numbers at the end of the citation may be purchased from U.S. Department of Commerce, National Technical Information Service, Springfield, Virginia 22161. For those who have difficulty in obtaining material from these sources, arrangements can be made to use the library of BCR on Monday through Friday between 8:00 a.m. and 4:00 p.m. Limited interlibrary loan service and photocopies, for a nominal fee and in conformance with copyright law, are also available. Please direct requests to Librarian, Bituminous Coal Research, Inc., 350 Hochberg Road, P. O. Box 278, Monroeville, Pennsylvania 15146.

Searching for and acquisition of coal-refuse disposal information is a continuing effort. Although coverage of the early literature is essentially complete, some more recently published material may not have been included. Copies of any publications not listed here, as well as of new publications, should be sent to BCR for inclusion in future issues of the Bibliographies. Any other suggestions, comments, or criticism of this publication are welcomed.

Additional copies of this publication and other bibliographies in the series may be obtianed from:

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ABSTRACT

This volume, the fifth to appear in the "Coal and the Environment Abstract Series," supercedes the May 1978 issue of "A Bibliography on Disposal of Refuse from Coal Mines and Coal Cleaning Plants." Almost 300 of the nearly 800 references are new to this bibliography. Some of the topics covered are analysis and characterization of refuse; methods of handling and disposing of refuse; environmental problems relating to air and water quality, and their control; refuse utilization; and reclamation of refuse disposal areas. In addition to the abstracts, this volume contains an Author Index and a General Index which includes names of organizations, geographic terms, and words and phrases describing the topics of the referenced documents. The other volumes in the series are "Bibliography on Mined-Land Reclamation," "Mine Drainage Bibliography 1910-1976," and "Mine Drainage Bibliography 1929-1980."

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FORMAT AND USE OF THE BIBLIOGRAPHY

The abstracts are grouped according to the year of publication, with each section being headed by its chronological designation. Within each year the abstracts are arranged alphabetically by the first author, or, if no personal author, by title. Each abstract is numbered sequentially within the year of publication and has its own unique number which is used to reference the abstract in the indexes. For example, in the number D76-42, the letter D indicates the general subject area of refuse from coal mining and coal cleaning plants, the next two digits refer to the year of publication, and the number to the right of the hyphen indicates the order in which that abstract is listed within the publication year. The one entry which does not follow this rule exactly is D00-1, the abstract number for an 1893 publication. At the end of each abstract are either letters, numbers, or various letter-number combinations. These are related to the filing of material in the BCR Library, and will aid the BCR staff in answering questions on the availability of the material.

The Author Index includes the names of all persons who have been listed as authors or editors of any publication. When an organization is shown as the author, it is listed in the General Index. Names beginning with Mc or Mac have been arranged alphabetically, as spelled, and are not grouped together.

The General Index includes the following categories: names of industrial, governmental, academic, or other organizations engaged in or sponsoring work related to refuse from coal mining or coal cleaning; geographic features such as names of foreign countries, of states and regions of the United States, and of rivers and lakes; and subject areas such as fluidized-bed combustion of refuse and refuse disposal. Terminology is as specific as possible and at the same time is controlled to provide consistency both within this volume and with the other volumes in the Series.

Federal government agencies are listed by name and are not grouped together under United States. As an example, Appalachian Regional Commission appears in "A" listings and Environmental Protection Agency appears in "E" listings. Both are identified as being part of the United States Government. Subordinate parts of government agencies also are used as main index entries, with cross references from the parent organization. Industrial Environmental Research Laboratory and and Crown Mine Drainage Field Site are both main entries and are cross references from Environmental Protection Agency.

State agencies are indexed using the name of the state as the initial word of the agency title. For example, Illinois State Geological Survey and Pennsylvania Department of Environmental Resources are used as main index entries.

Names of government agencies, companies, or academic units can change over the years through mergers, reorganization, or expansion. However, each document is indexed by the form of sponsoring- or performing-organization name as it appears on that document. Where the change is known, there is, in the index, a cross reference between related organizations.

In all categories, cross references and supplemental words and phrases are used liberally to facilitate information retrieval. All entries in the General Index are intermixed in strictly alphabetical order which follows the word-by-word method, with hyphenated words considered as one word.

The Appendixes are updates of the two other Bibliographies described in the Preface and appear after the indexes. Publications are listed alphabetically by author or title in each category: mined-land reclamation and mine drainage. No abstracts are included for these entries, nor are they indexed. However, abstracts of these publications will be included in the subsequent abstract bibliographies planned for each subject area.

1893

D00-1 REPORT OF COMMISSION APPOINTED TO INVESTIGATE THE WASTE OF COAL MINING WITH THE VIEW TO THE UTILIZING OF THE WASTE

Coxe, E. B., Thompson, H. S., and Griffith, W., Commonwealth of Pennsylvania, Legislative Commission Report, Philadelphia: Allen, Lane & Scott's Printing House, May 1893. 183 pp.+ A number of uses of waste as fuel are discussed. They include use in gas producers and manufacturing coke. The report also includes a list of literature on the subject. The Pennsylvania State Library PYC 6529. 1, CE400

1913

D13-1 HYDRAULIC MINE FILLING: ITS USE IN THE PENNSYLVANIA ANTHRACITE FIELDS: A PRELIMINARY REPORT

Enzian, C., U.S. Bureau of Mines, Bulletin 60 (1913). 77 pp. Coal mining and preparation waste is one of the filling materials discussed. Also considered in the report are surface and underground methods of conveying the filler, types of areas to be filled and bulkheads to contain the fill, and the effects of hydraulic filling on mine ventilation and drainage. D237

1922

D22-1 PYRITE FROM BITUMINOUS COAL MINES IN PENNSYLVANIA

Leighton, H., Pennsylvania Topographic and Geologic Survey, Bulletin No. 48 (1922). 19 pp. The results of a survey to determine the areas in which pyrite occurred is reported. The various modes of occurrence of the mineral with the coal are also described. The purpose of the study was to evaluate the feasibility of recovering pyrite as a raw material for the production of sulfur and sulfuric acid. PaGeol

1928

D28-1 ANTHRACITE CULM AND SILT

Sisler, J. D., Fraser, T., and Ashmead, D. C., Pennsylvania Topographic and Geologic Survey Bulletin M 12 (1928). 259 pp. The survey of the anthracite coal fields of northeastern Pennsylvania records the occurrence and character of silt and culm deposits. The use of silt and culm in manufactured anthracite fuels is described. The investigation of stream conditions in the area includes listing the method of disposal of breaker water by coal producers. A number used settling basins but some discharged water directly into the stream. PaGeol

1929

D29-1 THE ROLE OF STRATIFICATION IN THE SEPARATION OF COAL AND REFUSE ON A COAL-WASHING TABLE

Bird, B. M. and Davis, H. S., U.S. Bureau of Mines, RI 2950 (1929). 19 pp. A riffle table and two sizes of coal, 4 mesh and plus 20 mesh, were used to study the process whereby coal particles are separated from refuse. Details of the tests are given and the stratification is described. The object of the tests was to show that stratification, contrary to common belief, will not account for the separation effected by the coal washing table. Only enough water to maintain mobility should be used to give desirable action of the washing table. BurM

D29-2 UTILISATION OF COLLIERY PIT-BANKS

Thomson, P. M., The Scottish Forestry J. 43, 46-48 (1929). In February 1924 and again in September 1928, plantings which had been made in 1912 at Allhallows Pit, Cumberland, England, were surveyed. Results showed that of eleven species planted as seeds or seedlings, larch, Scots pine, and Sitka spruce could be grown on refuse. D326

1931

D31-1 PNEUMATIC STOWAGE MAKES RAPID STRIDES IN MINES OF GERMANY

Dierks, H. A., Coal Age 36, 466-468 (1931). Both high and low pressure systems are described. Coal washery refuse is one of the materials that can be used. Jour

D31-2 REFUSE DISPOSAL SYSTEM: CONTROLLED BY TOPOGRAPHY AND MAXIMUM CAPACITY DEMANDS

Coal Age 36, 630-632 (1931). The design of the refuse disposal area and the use of various types of refuse conveyors are discussed. Jour

D31-3 RE-TREATMENT OF SAYRETON JIG MIDDLINGS ON COAL-WASHING TABLES

Richardson, A. C. and Gandrud, B. W., U.S. Bureau of Mines, RI 3101 (1931). 6 pp. The Bureau of Mines and the University of Alabama cooperating with different coal operators made an extensive study of coal preparation in Alabama. Considerable time was devoted to washing characteristics of the Mary-Lee bed and the various methods used to prepare a low-ash coal suitable for making metallurgical coke. One phase devoted time in using middlings products from washing plants. BurM

1934

D34-1 METHOD AND APPARATUS FOR FEEDING AND SEPARATING DRY COAL FROM REFUSE

O'Toole, E., Sr., U.S. Patent 1,950,861 (March 13, 1934). 8 pp. The patent

D34-1 (continued)

describes a vibrating table with riffles and with perforations which allow air flow to separate the coal from the heavier refuse. USPat

1935

D35-1 NEW USES FOR ANTHRACITE COAL AND SLATE

Jones, D. J. and Buller, E. L. (The Hudson Coal Company), Industrial & Engineering Chemistry 27 (8), 953-954 (Aug. 27, 1935). The use of anthracite refuse as fillers in asphaltes used in paving and as concrete aggregates is noted. CE338

1936

D36-1 POSSIBLE RECOVERY OF COAL FROM WASTE AT ILLINOIS MINES

Smith, C. M. and Mitchell, D. R., University of Illinois, Engineering Experiment Station, Bulletin No. 285 (1936). 44 pp. To test the feasibility of recovering coal and other products, large samples of cleaning refuse were taken at 12 mines. Each sample was crushed, sized, and float-sink tested in the laboratory with results which indicate that in general about one-third of the material now rejected could be profitably recovered as marketable coal. CE46

1937

D37-1 TREATMENT APPLIED TO CONTROL A COLLIERY SPOIL HEAP FIRE

Price, H., The Colliery Guardian and J. of the Coal and Iron Trades 154 (3977), 533-535 (March 19, 1937). Problems of using water and slag to extinguish burning refuse-pile fires are discussed. Success in putting out refuse fires by piping limestone slurry into actively burning refuse is described. CE333

1938

D38-1 RECLAMATION OF REFUSE AT ILLINOIS COAL MINES

Mitchell, D. R. and Smith, C. M., Illinois State Geological Survey, Circular 23 (1938). pp 45-52. This discussion of the use of coal refuse as a source of pyrite for the production of sulfuric acid is mainly of historical interest. The economics of sulfuric acid production, including the effects on costs of hand or mechanical pyrite recovery and of the distance over which pyrite must be transported, are discussed in detail. D199

1939

D39-1 THE PLANTING OF TIPS AND SLAG HEAPS

James, N. D. G., Quarterly Journal of Forestry 33, 164-172 (1939). Colliery

D39-1 (continued)

waste is one of the types of waste materials considered. Species of trees successfully grown on burnt and on unburnt refuse are listed. D275

1940

D40-1 DARKENING LIGHT-COLOR SOILS WITH COAL-MINE WASTE

Broderick, S. J., U.S. Bureau of Mines, RI 3516 (1940). 6 pp. This article explains the advantage of dark soil over light colored soil, i.e., its ability to retain a higher temperature level thus promoting growth at an earlier date. Work done showed the temperature difference to be as high as 9 degrees F. Coal dust also adds some fertilizing value to the soil. A section on effects of coal-mine waste on crops is included. BurM

D40-2 SOME INFORMATION ON EXTINGUISHING AN ANTHRACITE REFUSE BANK FIRE NEAR MAHANOY CITY, PA.

Leitch, R. D., U.S. Bureau of Mines, IC 7140 (1940). 16 pp. The history of the refuse bank fire at the St. Nicholas Colliery of the Philadelphia and Reading Coal & Iron Company is related. An unsuccessful attempt was made to extinguish the fire by applying a limestone slurry through a number of holes made in the bank. The fire was finally controlled by excavation and isolation of the burning refuse. The description of this work includes a tabulation of the nature and causes of injuries received on the job. BurM

D40-3 MINERAL WOOL FROM ANTHRACITE COLLIERY REFUSE AND ANTHRACITE ASHES

Rose, H. J. and Johnson, R. C. (Mellon Institute), in Transactions of the Third Annual Anthracite Conference, Lehigh University, May 9-10, 1940. pp 45-54. This paper describes the work done by the authors in successfully preparing mineral wool from anthracite refuse and anthracite ashes. Pictures show the equipment used and the resulting product. Limestone is used as an additive and some fuel in the form of gas is needed. Steam can be used to control temperature. Economics given were favorable and there is no shortage of raw material. 662.6 A628

1941

D41-1 CARBONACEOUS CATION EXCHANGERS FROM COAL AND COAL REFUSE

Broderick, S. J. and Bogard, D., U.S. Bureau of Mines, RI 3559 (1941). 17 pp. Results showed that the use of Alabama bituminous-coal-mine waste as a raw material for making a granular water-softening product does not seem feasible because of the high loss of fines resulting from the activation treatment. However, both the clay and the coal fractions of the refuse showed distinct base-exchange properties. The clay portion of the refuse was activated into a base-exchange product by alkali, whereas coal was activated into a hydrogen exchanger by concentrated sulfuric acid. However, the coal was a more active

D41-1 (continued)

cation exchanger than the clay for water-softening purposes, so it is preferable to develop the activating procedure around coal. (From authors' Summary) D243

D41-2 ACTIVATED CARBON FROM COAL REFUSE FOR WATER PURIFICATION

Broderick, S. J. and Hertzog, E. S., U.S. Bureau of Mines, RI 3548 (1941). 27 pp. This work was done on refuse from the Colta mine, Mary Lee bed and from the Corona mine, Corona bed, both in Walker County, Alabama. Results showed that high carbon fractions could be activated readily by steam and by zinc chloride and that high ash content of refuse not only acted as an inert but also reduced the activity of the carbon. D244

1943

D43-1 POWER SALVAGED BY PROPERLY USING OTHERWISE WASTE COAL

Richart, F. W., Coal Age 48 (8), 65-69 (1943). This article reports the varying methods, problems, and successes in using fine coal, both dust and slurry, for power generation by Antioch Power Company, Linton, Indiana, by Central State Collieries, Canton, Illinois, by Chicago, Wilmington & Franklin Coal Company at its Orient No. 1 Mine, Orient, Illinois, and by the Princeton Mining Company, Princeton, Indiana. Jour

1944

D44-1 PRECISION JIGGING AS A SUBSTITUTE FOR A LABORATORY SINK-FLOAT

Coe, G. D. and Coghill, W. H., U.S. Bureau of Mines, RI 3769 (1944). 7 pp. This paper describes a method for sorting of particles by means of a laboratory batch jig. The purpose is to show that a material can be reliably appraised for gravity concentration without the drudgery of sink-float fractionations. BurM

D44-2 SALVAGE OF COAL FROM MINE REFUSE IN THE PITTSBURGH DISTRICT

Fraser, T., Kelley, J. A., and Graham, H. G., U.S. Bureau of Mines, RI 3768 (1944). 23 pp. This report describes a study of available coal in a number of refuse disposal areas in the Pittsburgh District of western Pennsylvania. Results of washability studies on samples of refuse are given. Methods of recovering coal from refuse are discussed. BurM

D44-3 PRECLEANER MATERIALLY INCREASES WASHER OUTPUT

Coal Age 49 (6), 78-80 (1944). Gilberton Coal Company, Gilberton, Pennsylvania, reclaimed anthracite coal by feeding refuse from an old bank to a shaker and a roughing jig which removed the higher gravity material before

D44-3 (continued)

it went to the preparation plant. Refuse from the preparation plant also goes through the precleaner. Final coal product can have as low as 9 percent ash. Jour

D44-4 ESTABLISHMENT OF VEGETATION ON COAL TIPS AND OTHER SPOIL MOUNDS

Sisam, J. W. B. and Whyte, R. O., Nature 154 (3912), 506-508 (1944). Before the areas are planted, information should be obtained on the degree of weathering of the material, on the nutrient or toxic status, and on soil moisture and tip drainage. On poor material, or if topsoil is not spread, grasses or trees that have low fertility requirements and that will add humus to the soil are suggested for initial plantings. Specific tree planting techniques are discussed. D279

1945

D45-1 LARRY TRAIN SOLVES OAK HILL REFUSE-DISPOSAL PROBLEM

Richart, R. R., Coal Age 50 (11), 103-108 (1945). Philadelphia and Reading Coal & Iron Company in Minersville, Pennsylvania, used a four car larry train on grades up to 10 percent to haul refuse higher on the dumping area. The electrical system used to power the train is described in detail. Jour

1947

D47-1 EFFECTS OF STOWING ON SURFACE SUBSIDENCE

Transactions, The Institution of Mining Engineers 107, 58-61 (1947-1948). Pneumatic and hydraulic stowing of coal refuse material to prevent surface subsidence are discussed. Some experience at British mines is included. D253

D47-2 WASHER RECLAIMS BANK COAL

Coal Age 52 (8), 92-93 (1947). At the Six K Coal Corporation, Clarksburg, West Virginia, refuse with 30 percent coal is fed to a washer-conveyor. Calcium chloride, or other media, is used to float the coal which is continuously removed by the conveyor and dewatered. Jour

1948

D48-1 BURNING REFUSE DUMPS AT COAL MINES

Harrington, D. and East, J. H., Jr., U.S. Bureau of Mines, IC 7439 (1948). 28 pp. This publication discusses all phases of refuse dumps including combustible material, causes of fire, products of combustion, methods of constructing refuse dumps, examples of refuse dump fires, and fatal accidents at burning refuse dumps. A number of recommendations are given for extinguishing burning refuse dumps. BurM

1949

D49-1 BRUSHING WITH ROOM STOWAGE

Coal Age 54 (9), 82-83 (1949). To provide clearance for cars, the Williams Coal Company, Mannington, Kentucky, removes either top or, preferably, the bottom of the 42-inch seam and places rock material in specially driven rooms. The work of the 5-man crew is described. Jour

1950

D50-1 MINE REFUSE DISPOSAL

Cuthbert, W. R., Hanson, V. D., Perkins, G. N., and Vogel, L. J., "A report by a surface preparation sub-committee of the AMC coal division," Mining Congress Journal 36 (1), 43-46 (1950). Merle, J. J., Hicks, H. N., Caler, W. R., and Weber, D. A., "Washery disposal at strip mines," Mining Congress Journal 36 (1), 46-47 (1950). Various methods of handling refuse under different conditions are described. D158

D50-2 RECOVERING SLUDGE AT HARCO

Coal Age 55 (9), 84-87 (1950). Peabody Coal Company at its Harco Mine in Harrisburg, Illinois, reclaimed its sludge pond material at the rate of 250 tons/shift. The 28m x 0 coal is sold for pulverized fuel. The two ponds used in turn are allowed to drain before material is taken to the drying plant. Dried coal is discharged continuously while sludge is being fed to the dryer. When cars are loaded, 18 gallons of heavy base oil at between 120 and 150 F are sprayed over the coal thus waterproofing it and preventing transit loss. D162

1951

D51-1 HYDRAULIC STOWING IN PENNSYLVANIA

Colliery Engineering 28 (329), 281 (1951). Three case histories reported by H. Merton Ruth, Division Superintendent, Glen Alden Coal Company, Wilkes-Barre, are of pillar recovery and control of surface subsidence with mechanical or hydraulic stowing of mining and preparation plant refuse. D231

D51-2 PROCESSING TAILINGS INTO LIGHTWEIGHT AGGREGATES

Lenhart, W. B., Rock Products 54, 94-95, 107-108 (Sept. 1951). The Lehigh Materials Company made lightweight aggregate by vitrifying anthracite refuse on a traveling grate. The continuous ribbon of molten product is cooled and crushed and meets A.S.T.M. specifications for use in concrete. Details of the process and equipment are given. D273

D51-3 NO GOB FIRES . . . MORE GOODWILL

Coal Age 56 (5), 91-93 (1951). Christopher Coal Division of Consol extinguished its burning refuse piles near Morgantown, West Virginia, by

D51-3 (continued)

smoothing the piles with dirt and stepping, trenching, and earth-filling as needed. The method of building and compacting new piles to prevent burning is described. D163

D51-4 SOME GERMAN EXPERIMENTS IN THE GASIFICATION OF WASHERY REJECTS AND PULVERIZED FUEL

National Coal Board, Production Department, Information Bulletin No. EG (51) 9. (undated). 6 pp.+ This Bulletin describes the work carried out in Germany during World War II to develop an economical process for gasifying refuse from coal washing. D187

D51-5 STONE PREPARATION FOR POWER STOWING

National Coal Board, Production Department, Information Bulletin No. MM (51) 8. (undated). 6 pp.+ Materials referred to in this publication include washery dirt, pit dirt, screen pickings, and tip dirt. In each case some preparation for both mechanical and pneumatic stowing is required. Restrictions for mechanical stowing are far less rigid than those for pneumatic stowing. Designs for crushing and stone preparation plants are included in diagramatic form and there are comments on various crushers and other handling equipment. D186

D51-6 PRESSURE-DROP IN PNEUMATIC STOWING PIPE-LINES

Whetton, J. T. and Broadhurst, P. H., Transactions, The Institution of Mining Engineers 111, 920-936 (1951-1952). Further discussion of the paper, Transactions, The Institution of Mining Engineers 112, 352-354 (1952-1953). While the paper is mainly concerned with the analysis of pressure drop, the authors also discuss particle motion, velocity of conveying air, and the effects of pipe bends. D195, D196

1952

D52-1 POWER PACKING

Naylor, A. E. and Thompson, J. S., The Colliery Guardian 184 (4743), 95-99 (Jan. 24, 1952). The modification and use of equipment for packing mining refuse in worked-out sections at Shirebrook Colliery are described. D200

D52-2 A PROPOSED SEALED CIRCULAR COAL-REFUSE PILE

Nelson, W. L. and Hall, E. P., Mechanization 16 (12), 85-89 (1952). Plan and elevation views of a proposed circular coal-refuse pile are shown indicating constructional features including the permanent clay seal and the access road. The pile is built at 2 ft layers compacted with a clay seal on the wall of each 3 layers. Each wall is set back from the underlying wall to reduce erosion. The pile also has a road of crushed rock built into it. A table contains calculated volumes and costs of sealed circular coal-refuse piles. D101

D52-3 POWER STOWING OF RIPPING DIRT

National Coal Board, Production Department, Information Bulletin No. 52/67 (undated). 7 pp. This publication describes an underground method for handling coal refuse mechanically. The system uses a scraper bucket which is moved in two directions by an assembly of ropes. A diagramatic sketch illustrates how the material is moved. Emphasis is on the labor saving features of the method and labor requirements. Power needs are given. D188

1953

D53-1 DIRT DISPOSAL BY DUMP TRUCK

National Coal Board, Production Department, Information Bulletin No. 53/100 (undated). 6 pp.+ This British publication refers to the problem of covering coal refuse at the time of mining to make the land usable for other purposes. The discussion concerns trucks most suitable to do this. A number of truck sizes and the economics involved are discussed. D178

D53-2 STREAM POLLUTION BY COAL MINE WASTES

Hebley, H. F., Transactions of AIME 196, 404-412 (1953). This paper is a general description of the nation's water resources. It touches on the phenomenal growth in demand for water supply and emphasizes the problems facing the coal industry both with regard to acid mine water drainage discharged from active and abandoned mines and the suspended solids discharged to the stream system from wet coal preparation plants. 53-9

D53-3 WASTE DISPOSAL PROBLEMS IN THE COAL MINING INDUSTRY

Hodge, W. W. (Mellon Institute), in "Industrial Wastes," W. Rudolfs, Ed., New York: Rheinhold Publishing Corp., 1953. pp 312-418. Coal refuse handling and storage, and attendant problems, are discussed in detail. 628.2 R917

D53-4 AFFORESTATION OF INDUSTRIAL WASTE LANDS

James, N. D. G., Quarterly Journal of Forestry 47, 170-179 (1953). Colliery waste is one of the several types of industrial waste considered. Various tree species recommended for this waste are noted, as are several refuse heaps which had been planted a number of years previously. D278

D53-5 ANTHRACITE MECHANICAL MINING INVESTIGATIONS PROGRESS REPORT 6; PRELIMINARY TESTING OF BRIEDEN PNEUMATIC PACKING MACHINE

Landsidle, C. A., Hartley, J. C., and Buch, J. W., U.S. Bureau of Mines, RI 4978 (1953). 13 pp. Although the emphasis in this report is on the packing machine and its operation, the preparation plant refuse used for packing is described. It was noted that anthracite refuse appeared to be ideal for pneumatic packing and no serious trouble was experienced from the fines. BurM

1954

D54-1 CONTINUOUS MINING WITH SOLID PNEUMATIC STOWING AT DONISTHORPE COLLIERY

Bennett, H. B. (National Coal Board, East Midlands Division), The Colliery Guardian 189 (4896), 811-819 (Dec. 30, 1954). Burnt refuse from the tip at the colliery was used to backfill an area in which pillars were being extracted. The author describes the transport of the refuse on the surface, the abrasion of the basalt-lined pipes and of other piping materials tested in conveying the material underground, and the methods of stowing in conjunction with the use of a continuous miner. D202

D54-2 HOW TO STOP POLLUTION

Gilbert, A. G. (Heyl & Patterson, Inc.), Coal Age 59 (12), 62-65 (1954). Cyclones, with vibrators, filters, and centrifuges; two-stage thickening; flocculation, froth flotation, and settling ponds are all in use to clarify water from coal preparation plants and at the same time recover coal. The application of various combinations of these methods in closed systems and in open circuits is discussed. Jour

D54-3 FINAL SUMMARY REPORT OF WESTERN PENNSYLVANIA COAL OPERATORS ASSOCIATION INDUSTRIAL FELLOWSHIP NOS. 1, 2, 3, 4, AND 5, JAN. 1949 TO MAY 1954

Nelson, W. L., Mellon Institute, Fellowship No. 336, 1954. 82 pp. Objects of the work under these fellowships were to investigate fundamental aspects of spontaneous heating of coal refuse piles and to develop practical methods of preventing and extinguishing refuse fires. A limited number of tests have been made on actual refuse sites. 54-34

D54-4 A POWER-STOWING INSTALLATION

Colliery Engineering 31 (366), 226-233 (June 1954). The Shirebrook-slusher method of handling mine refuse was observed at a Gedling colliery face near Nottingham. The main equipment used were double drum scraper hoists, slusher buckets, and wire ropes and rope sheaves. The particular function of each of these mechanisms, alone and in conjunction with one another, is given. In addition, the job functions of the scraper-packing team of three men are described. Some of the gateside packs had to be hand-built because not enough space was available for the necessary mechanical stowing equipment. D201

D54-5 SOME OBSERVATIONS ON TRIALS WITH DUMP TRUCKS (SUPPLEMENT TO INFORM. BULL. 53/100)

National Coal Board, Production Department, Information Bulletin No. 54/112 (undated). 7 pp.+ The economics of using several types of dump trucks in coal refuse disposal are evaluated. The trials were carried out under conditions devised to simulate the most adverse situations that might be encountered. D179

1955

D55-1 CONVERSION INTO AGGREGATE: ANSWER TO REFUSE PROBLEM

Coal Age 60 (11), 78-81 (1955). Trulite Corporation at Ceredo, West Virginia, was founded to relieve the refuse disposal problem of Truax-Traer Coal Company. Since the raw refuse contained 40 to 50 percent combustible, mainly carbonaceous shale, a combustion system was developed to prepare the aggregate. The process and equipment are described. Jour

D55-2 THE PROGRESS OF MECHANISED PACKING IN NORTH STAFFORDSHIRE

Cope, E., Colliery Guardian 191 (4934), 351-354 (Sept. 22, 1955). After twelve months of scraper packing at two collieries, more than 560,000 tons of refuse were compressed in underground workings. Since refuse was channelled directly to the stowing site, the amount of refuse disposal and run-of-mine refuse in preparation operations above ground was greatly reduced. In addition, scraper packing helped to improve ventilation across the face and control spontaneous combustion in the refuse. D204

D55-3 PNEUMATIC STOWING AT HOLDITCH COLLIERY

Fletcher, L. W., Colliery Guardian 190 (4917), 641-643 (May 26, 1955). The decision to pneumatically stow refuse material in old workings underground resulted from needs to reduce surface subsidence, to improve underground ventilation conditions at the face, to prevent gas accumulation and to reduce the disposal of refuse above ground. A general description of the stowing procedure is given. Further benefits obtained from solid stowing are improvements in roof control at the face, better safety records than where strip packing is practiced and a reduction in manpower needed to pack the face. D203

D55-4 RECOVERY OF COAL FROM WASHERY REFUSE: SOME EXAMPLES OF THE EFFECT OF CONTINUOUS MINING MACHINES ON PREPARATION PROBLEMS

Geer, M. R., Fennessy, F. D., and Yancey, H. F., U.S. Bureau of Mines, RI 5152 (1955). 45 pp. Cleaning trials were made on three samples of jig refuse in a dense-medium pilot plant to demonstrate the application of this process to the recovery of coal from waste. These tests showed that coal could be separated from impurity with the same degree of sharpness obtained in treating raw coal by dense-medium. It may be economically feasible to re-treat all or a portion of the washery refuse to recover the coal lost in the primary cleaning units. Dense-medium process is especially attractive for re-treating refuse because of the inherent sharpness with which it can separate coal from impurity. (From authors' Summary and Introduction) BurM

D55-5 USE OF PULVERIZED ROCK AS DENSE MEDIUM FOR SALVAGING COAL FROM PITTSBURGH-BED REFUSE

Palowitch, E. R., Jolley, T. R., and Sokaski, M., U.S. Bureau of Mines, RI 5184 (1955). 33 pp. This investigation dealt with the mechanical recovery of coal from mine refuse by a dense-medium washery employing pulverized mine rock

D55-5 (continued)

as the dense medium and operating at the rate of 175 tons per hour. The two types of mine refuse tested were freshly mined refuse and refuse mined two years before and piled on a waste dump. Feed to the washbox and clean coal and refuse products from the washing operation were sampled and the samples were evaluated to calculate the recovery efficiency. With the weathered mine refuse, recovery was 27.5 percent clean coal which analyzed 8.5 percent ash and 1.47 percent sulfur. The freshly mined refuse yielded 20.8 percent clean coal which analyzed 8.1 percent ash and 1.83 percent sulfur. (From authors' summary) BurM

D55-6 RECOVERING RIVER COAL

Coal Age 60 (5), 78-83 (1955). Pennsylvania Water & Power Company coal recovery plant at Safe Harbor, Pennsylvania, on the Susquehanna River is described. Refuse and effluent from washing and dewatering operations are disposed of in a basin built by damming a valley in the area. Sandy refuse from flotation and tabling is used to increase the height of the dam. Slimes from the clarifier and effluent from the dewatering process are sent to the main settling basin. A concrete runoff pipe laid under the dam carries off clarified water drawn from the top of the pool through a stand pipe. Jour

1956

D56-1 CRUSHING STOWING MATERIAL

Colliery Engineering 33 (388), 264 (1956). This abstract of a German article shows two views of a crushing plant installed at Ickern Colliery in the Ruhr to handle washery discard and picked refuse from its own operation and additional dirt from other collieries, all of which was required for stowing. D249

D56-2 THE CONTROL OF GOB PILE FIRES

Hebley, H. F., J. Air Pollution Control Association 6 (1), 29-31, 51 (1956). The cause of refuse pile combustion is discussed and methods of construction to prevent burning are described. D192

D56-3 DISPOSAL OF COLLIERY WASTES

Lessing, R., Colliery Guardian 193 (4970), 153-154, 156-157 (Aug. 2, 1956). One of the problems of refuse disposal is burning refuse piles. The causes of fire in refuse piles and difficulties experienced in Great Britain in control and prevention of refuse fires are reviewed in detail. Other considerations of refuse disposal, such as the amount of land needed for refuse piles, and recovery of the fuel value in refuse, are also discussed. D205

D56-4 LOW-COST BANK RECLAMATION

Coal Age 61 (11), 72-75 (1956). The Black Star Anthracite Company of Hazelton, Pennsylvania, processes 2250 tons/day via heavy media to recover coal from culm bank material. Recovery averages 7 to 12 percent. Jour

D56-5 DENSE-MEDIUM PILOT-PLANT PERFORMANCE TESTS ON COAL

Palowitch, E. R., Sokaski, M., and Jolley, T. R., U.S. Bureau of Mines, RI 5212 (1956). 52 pp. This report is the result of a series of coal-cleaning tests using a dense-medium cone-type washer. Detailed results are given for two tests using magnetite medium and four tests using a pulverized-refuse medium. BurM

D56-6 THE DISPOSAL OF COAL REFUSE: TECHNICAL COORDINATING COMMITTEE T-4 COAL REPORT

Rose, H. C., Corey, R. C., Engdahl, R. B., Foster, J. J., and Garvey, J. R., J. Air Pollution Control Association 6 (2), 105-110 (1956). This report describes spontaneous heating in refuse piles and gives directions for construction methods to prevent ignition and burning. D193

D56-7 ANTHRACITE MECHANICAL MINING INVESTIGATIONS, SECOND TESTING OF BRIEDEN PNEUMATIC PACKING MACHINE

Whaite, R. H., U.S. Bureau of Mines, RI 5273 (1956). 22 pp. A pneumatic packing machine from Germany, installed in a mine in the anthracite region of Pennsylvania, was used to stow 3" x 0 refuse. Although the project showed that refuse could be packed in this way, pillars were not removed so the effectiveness against subsidence could not be evaluated. BurM

1957

D57-1 THE AFFORESTATION OF PIT HEAPS IN COUNTY DURHAM

Atkinson, J. R., Laurie, I. C., and Clay, A. J. M., Planning Outlook, The Journal of the School of Town and Country Planning, King's College, University of Durham 4 (3), 45-52 (1957). J. S. Allen, Ed., London: The Oxford University Press. The history of planting efforts on refuse piles, from as early as 1928, is reviewed. A survey of areas planted before World War II shows differences in appearance from using various types of vegetation. Current experience and problems of planting trees on refuse piles are discussed. CE763c

D57-2 AUTOMATIC REFUSE PUMPING

Coal Age 62 (11), 72-73 (1957). An automatic variable-speed-control pumping installation which conveys variable loads of coal washery water to a settling pond about 350 ft. above and 1300 ft. away from the preparation plant is used by the Red Parrot Coal Company, Division of North American Coal Corporation, in Prenter, West Virginia. Jour

D57-3 THE REHABILITATION OF MINE AND INDUSTRIAL WASTE HEAPS

Bates, A., Planning Outlook, The Journal of the School of Town and Country Planning, King's College, University of Durham 4 (3), 59-64 (1957). J. S. Allen, Ed., London: The Oxford University Press. The extent of refuse disposal areas on the land surface and the projected growth of refuse piles are discussed. Some experiments toward inducing vegetation on refuse piles are reviewed. CE763e

D57-4 BIG-VOLUME REFUSE DISPOSAL AT VESTA-SHANNOPIN PLANT

Coal Age 62 (7), 76-79 (1957). The refuse handling system at the Jones & Laughlin plant includes a combination stationary and portable belt conveyor and a movable stacker which distributes the refuse in a preplanned pattern in the disposal area. The details of the system and some experiences in the first several years of operation are described. Jour

D57-5 THE ECOLOGY OF DISUSED PIT HEAPS IN ENGLAND

Hall, I. G., J. Ecology 45, 689-720 (1957). In this survey carried out in 1952, more than one hundred sites were visited. All species found on the refuse piles are listed. The types of plants found were related to the age of the refuse pile, with trees and woody plants on the oldest and a distinctive pioneer herb-grass community on the youngest. Differences between vegetation on burnt and unburnt refuse were also identified and discussed. D327

D57-6 HOW Y & O CONTROLS STREAM POLLUTION

Coal Age 62 (11), 84-86 (1957). The Youghiogheny and Ohio Coal Company at Van, West Virginia, built settling ponds on top of their refuse banks. Solids settle out and water draining through the bank and entering streams can meet West Virginia Water Control Commission standards. The pond area and pumping facilities are described. Jour

D57-7 DERELICT PIT HEAPS AND THEIR VEGETATION

Richardson, J. A., Planning Outlook, The Journal of the School of Town and Country Planning, King's College, University of Durham 4 (3), 15-22 (1957). J. S. Allen, Ed., London: The Oxford University Press. The natural plant communities which have become established on refuse piles in England are described. A number of factors influencing plant colonization are identified, and effects of weathering and the chemical breakdown of pyrite are discussed at length. CE763a

1958

D58-1 METHODS OF UTILIZING SHALE FROM DIRT HEAPS

Brison, L. and Moiset, P., Third International Coal Preparation Conference, Brussels-Liège, Belgium, June 23 - 28, 1958, English Text, Editions des "Annales des Mines de Belgique" (undated). pp 641-644. The processing of

D58-1 (continued)

coal refuse to give cleaned coals, with varying ash content, and material for use in pneumatic stowing is described. 662.6 I927

D58-2 PHANTOM PRODUCT - - - MINE WASTE

Charmbury, H. B., Mechanization 22 (5), 46-52 (1958). The nature and extremely large amount of refuse from coal mining and coal cleaning and various methods of handling and disposing of this refuse are discussed. D272

D58-3 70-YD KING OF SPADES: PACESETTER AT NEW RIVER KING

Flowers, A. E., Coal Age 63 (1), 76-87 (1958). There is a short description of the refuse handling method at the coal cleaning plant at Peabody Coal Company's River King Mine near Freeburg, Illinois. Clarified overflow from the settling pond goes into the plant's fresh water supply so that no plant water goes into the outside stream drainage. Jour

D58-4 THE EFFECT OF TEMPERATURE ON THE GROWTH OF PLANTS ON PIT HEAPS

Richardson, J. A., J. Ecology 46 (3), 537-545 (Nov. 1958). Because of the composition and slope of pit heaps high temperatures may persist in the surface layer for several hours daily in the summer. Temperature records from observations made at Ouston, County Durham, show the ameliorating effect of the presence of colonizing species. The rate at which pioneer species become established appears to be accelerated by the presence of a moss-lichen layer. (From author's Summary) D307

D58-5 GOOD PREPARATION DESIGN

Zacher, F. R. (Christopher Coal Company), Coal Age 63 (3), 100-103 (1958). A general discussion of plant refuse handling and disposal is included as one of the considerations in preparation plant design. Jour

1959

D59-1 THE USE OF COAL WASHERY TAILINGS AND OTHER WASTE PRODUCTS IN THE MANUFACTURE OF BRICKS

Gilbert, W., Marriott, E., and German, W. L. (North Staffordshire Technical College), British Ceramic Society Transactions 57 (5), 258-268 (May 1959). The experimental work reported shows that refuse from coal cleaning plants can be used satisfactorily, alone or with burnt refuse or fly ash from power plants, in the manufacture of bricks. D206

D59-2 REFUSE FOR DENSE-MEDIUM CLEANING

Walter, L., Mechanization 23 (10), 71-73 (1959). At "Manvers Main" Central Coal Preparation Plant, the output of four collieries mining five different coal beds is treated in three almost identical parallel coal cleaning systems. Reject from the froth flotation is used to provide the dense medium in the

D59-2 (continued)

baths. Details of the cleaning process, including control of specific gravity, and descriptions of the cleaned coals are given. D268

1960

D60-1 ALUMINUM MAY BE EXTRACTED FROM COAL MINE WASTE BY NEW PROCESS

Modern Metals 16, 54 (Sept. 1960). The joint venture of North American Coal Corporation and Strategic Metals Corporation to extract alumina from coal refuse is described. D208

D60-2 COAL MINING FIRM GETS SET TO PRODUCE ALUMINUM

Steel 146, 54 (June 6, 1960). This article gives a brief description of the process being developed by North American Coal Corporation to extract aluminum from coal refuse as aluminum sulfate and aluminum oxide. D209

D60-3 GASIFICATION OF BONE ANTHRACITE

Eckerd, J. W., Clendenin, J. D., Sanner, W. S., and Morgan, R. E., U.S. Bureau of Mines, RI 5594 (1960). 24 pp. The Wellman-Galusha standard gas producer was used to gasify bone anthracite. The results showed that for high ash coals the equipment would need considerable modifications since fuel bed conditions could not be stabilized. Clinkers formed and uniform air distribution was never satisfactorily maintained. BurM

D60-4 DUST HAZARD CAUSED BY PNEUMATIC STOWING

Hubert, E., Colliery Guardian 200 (5167), 457-463 (April 28, 1960). Widely varying amounts of dust have been observed with pneumatic stowing of coal refuse and other materials in underground coal mines. A detailed review of the factors affecting dust generation includes discussion of the source of the stowing material, the mineral composition of the fine dust, the importance of moisture content of the stowing material, and the influence of operating conditions and stowing machinery. D207

1961

D61-1 AUTOMATED ANTHRACITE PROCESS SAVES WASTE

Metallurgia 64, 238 (Nov. 1961). Magnetite is used as the dense medium in the process that allows recovery of fine coal from refuse and produces cleaned coal with a uniform ash content. Because of the high rate of recovery of the dense medium only 0.4 lb per ton of raw coal is needed. D266

D61-2 AUTOMATIC REFUSE DISPOSAL

Coal Age 66 (3), 86-87 (1961). An automatic aerial tramway, carrying 70 tph to a refuse disposal area is described. The tramway is used instead of building a roadway in the mountainous terrain. Jour

D61-3 LOW PRESSURE STOWING WITH A SCREW COMPRESSOR

Mining Journal 256, 332-333 (March 24, 1961). The experience of the National Coal Board with low pressure stowing is described and the advantages of a screw compressor are pointed out. D285

D61-4 THE PERMEABILITY OF HYDRAULIC FILL MATERIALS

Mickle, D. G., Jr., The Pennsylvania State University, M.S. Thesis, 1961. 42 pp. This study was concerned with the effect of particle size on the permeability of hydraulic mine fills. As far as possible other variables were kept constant. Laboratory investigations were carried out with samples of coal-washer refuse, sand, mill tailings, boiler ashes, and glass spheres. Permeability was determined both for narrow size ranges and for samples containing several size ranges in various proportions. Predicted permeabilities were found to be fairly accurate for samples with permeabilities below 6 inches per hour. The error for values above this permeability was believed to be caused by departure from laminar flow. Permeability of fine-grained materials could be predicted with satisfactory accuracy. D242

D61-5 PERMEABILITY AND COMPRESSIBILITY TESTS AID IN SELECTING SUITABLE HYDRAULIC FILL MATERIALS

Mickle, D. G. and Hartman, H. L., Mining Engineering 13, 1246-1248 (1961). This paper describes test work done on five sizes of coal washer refuse to evaluate their performance as hydraulic fill materials and give compressibility and permeability data. All materials obtained in the anthracite region had suitable permeability. Jour

D61-6 UNDERGROUND STOWING

Orchard, R. J., Colliery Guardian 203 (5237), 258-263 (Aug. 31, 1961). The author discusses the mechanics of subsidence and gives examples of the effects of various methods of refuse stowing on subsidence. The greatest reduction of subsidence occurred with pneumatic stowing of refuse. It is pointed out that while refuse can provide some support, additional material from outside the mine is needed for greatest subsidence control. The example given of this is the use of sand from quarries in packing mines in Poland. In discussing various factors involved in the costs of stowing, it is noted that these costs have, in Great Britain, generally been greater per ton of coal produced than the costs of repairing surface damage from subsidence. D210

D61-7 PREPARATION OF PIT STONE FOR STOWAGE

Colliery Engineering 38, 332-335 (1961). The article describes the plant for preparing crushed, graded stone from mining waste for stowing underground at Glyncorrwg Colliery, Glamorganshire, Wales. D211

1962

D62-1 IMPROVEMENTS IN OR RELATING TO THE UTILIZATION OF WASTE MATERIAL

Becker, F., Kulcsar, I. G. G., Palotai, L., and Reviczky, F. (to Nikex Nehezipari Kulkereskedelmi Vallalat), British Patent 913,177 (Dec. 19, 1962). 4 pp. Coal mine waste is processed by crushing, suspending it in water, and passing the slurry through a hydrocyclone to obtain coal-rich and coal-poor fractions. Density of the suspension is controlled and the size consist of the material is kept within specified limits. Examples are given of coal-poor fractions used in brick manufacture and mine filling. D194

D62-2 CRUSHER STOWING

Cadman, W. B. and Weston, G., Mining Engineer 121, 809-821 (1962). Experience in low-pressure stowing at three mines in the United Kingdom is discussed. Equipment developed by Markham & Company, Ltd., was used in the mines for crushing material produced in mining and for returning it directly to the area to be packed. This process resulted in better face conditions, reduction in damage due to subsidence, and the ability to continue faces under built up areas. D213

D62-3 PELLETIZING PROCESS RECOVERS MARKETABLE COAL FROM SLURRY

Charmbury, H. B., Coal Utilization 16 (9), 19-22 (1962). Coal pellets were prepared from the slurry overflow from settling tanks for clean coal. It was estimated that 300 to 500 tons per day of marketable product was recovered. 440.3 62-1

D62-4 COAL FINES ARE SUCCESSFULLY PELLETIZED

Coal Age 67 (11), 125 (1962). Dravo Corporation, at its research center, pelletizes coal fines using a lignosulfate paper mill waste and bentonite. The pellet can be handled and dries to an excellent strength. Filter cake material was also pelletized using the Dravo-Lurgi disks. Several companies now use the process commerically. Details of the pelletizing techniques are included. Jour

D62-5 PROCESSING AND DISPOSAL OF COAL FLOTATION TAILINGS

Dahlstrom, D. A., Mining Congress Journal 48 (3), 50-55 (1962). Methods of dewatering refuse from fine coal recovery operations are described in detail. D267

D62-6 COAL REFUSE FOR BUILDING MATERIALS

Edwards, J. A., Colliery Guardian 205, 340-346 (1962). This article reviews the work of the U.S. Bureau of Mines with material from the Trulite Corporation which produced aggregate from refuse at a Truax-Traer mine in West Virginia and from refuse supplied by the Carbon Fuel Company, West Virginia. Results showed that characteristics of the refuse determined whether or not a

D62-6 (continued)

satisfactory aggregate could be made with or without additives. The effects of varying conditions in the pelletizing furnace are discussed. D214

D62-7 FINE COAL RECOVERY AND MINE BACKFILL PREPARATION

Mechanization 26 (10), 30-34 (1962). Sunnyside Coal Mines of Kaiser Steel Corporation in Utah use flotation cells to recover fine coal. The refuse slurry, pumped back into the mines for roof support, is not deslimed since it was found that slime content had no detrimental effects and improved pumping characteristics. A detailed flowsheet of the coal recovery is included, and the process and equipment are described. D215

D62-8 AIR POLLUTION FROM COAL REFUSE PILES

Hall, E. P., Mining Congress Journal 48 (12), 37-41 (1962). Methods of extinguishing fires in refuse piles and methods of handling refuse and constructing piles to prevent combustion are discussed. D256

D62-9 INVESTIGATIONS ON THE OPERATION OF THE CIRCULAR CONCENTRATOR FOR CLEANING FINE COAL

Kindig, J. K. and Charmbury, H. B., The Pennsylvania State University, Department of Mineral Preparation, Special Research Report to Pennsylvania Coal Research Board, SR-30 (1962). 78 pp. A number of runs were made on the Cannon circular concentrator, a launder-type punched sluice device to clean fine coal. 662.6 P4

D62-10 FLOCCULATION AND THICKENING COAL-WASHERY REFUSE PULPS

Matheson, G. H. and Mackenzie, J. M. W., Coal Age 67 (12), 94-100 (1962). The theory of electrolyte and polymer flocculation is related to laboratory and plant results. A conclusion is that for maximum benefits from flocculant addition, thickeners should be operated with a considerable volume of clear water to permit adequate dilution of the incoming feed and promote floc growth. Jour

D62-11 USING COAL REFUSE IN BUILDING MATERIALS

Myers, J. W., Pfeiffer, J. J., and Orning, A. A., Transactions of AIME 223, 53-61 (1962). To process washery refuse for use as a building material aggregate, it was crushed and pelletized before being sintered in a small pilot plant using a traveling grate. One product was evaluated commercially in building blocks. Aggregate was evaluated for staining, free organic matter, and size. Some fluxing lime was used to lower sintering temperature. Refuse materials vary considerably and processing may or may not give an acceptable product. Jour

D62-12 RECOMMENDATIONS FOR THE CONSTRUCTION AND SECURING OF SLOPES (EXTRACTS)

Working Party 8a for "Stability of Slopes and Slips," of Subcommittee B of the German Association for Soil and Foundation Structures, Die Bautechnik 39 (12), 404/415 (1962). National Coal Board Translation A.2699/AGR. 2 pp. In preparing the ground before building a waste disposal pile the water should be drained off and non-load-bearing ground should be removed unless it is possible to ensure a firm base in some other way. Methods of slope and soil stabilization are summarized. D234

D62-13 SIMULTANEOUS COAL GETTING AND STOWING

Colliery Engineering 39, 204-205 (1962). The operation at Monk Bretton Colliery near Barnsley is described. Coal is being mined on three shifts a day and refuse is being stowed simultaneously on two shifts. D212

D62-14 IMPROVING FINE-COAL FILTERING

Swan, J. D. (Consolidation Coal Company), Coal Age 67 (11), 90-92 (1962). The results of a laboratory study to improve the handling characteristics of the cake from the vacuum filtration of coal fines are given. In a demonstration run, a combination of surfactant and flocculant changed the filter cake from being wet, rubbery, and hard to handle to a cake that had less moisture and was brittle. Jour

1963

D63-1 BELT LOADER RECLAIMS CULM BANK

Coal Age 68 (10), 178 (1963). The article describes the machinery and method of operation used by D. A. Kessler Construction Company to move coal refuse. The material was processed by Wright Coal Company, Trevorton, Pennsylvania, to recover anthracite fines. Jour

D63-2 A GUIDE FOR SCREEN AND COVER PLANTING OF TREES ON ANTHRACITE MINE-SPOIL AREAS

Frank, R. M., U.S. Department of Agriculture, Northeastern Forest Experiment Station, Forest Service Research Paper NE-22 (1963). 50 pp. The guide describes the maps prepared for major communities, counties, and the entire anthracite region, showing areas disturbed by surface mining, areas used for disposal of refuse from deep mining, and potential planting sites needed to screen these areas from view or to cover them. Planting stock requirements are also reviewed. R197

D63-3 HORIZONTAL FINE-COAL RECOVERY SCREENS HELP BOOST PROFITS

Coal Age 68 (6), 132 (1963). The use of horizontal vibrating screens for recovery of fine coal is described. Jour

D63-4 COMPARATIVE STUDY OF SOLID STOWING METHODS

Kis-Tamas, L., Colliery Guardian 207, 547-552, 586-590 (1963). In this entry in the Students' Prize Competition, hydraulic and pneumatic stowing and the various system design characteristics are discussed. The use of reserve refuse from the surface in addition to current mining refuse and washery reject is also considered. A detailed plan is given for the extraction and stowing of two seams close to each other at the Ellistown North and Central Districts. D219

D63-5 COAL FLOTATION OF LOW-GRADE PENNSYLVANIA ANTHRACITE SILTS

Liu, H. S. and Sun, S. C., The Pennsylvania State University, Department of Mineral Preparation, Special Research Report to Pennsylvania Coal Research Board, SR-39 (1963). 126 pp. A flotation method was developed to upgrade silts of 40 to 53 percent ash to clean coal of 14 to 16 percent ash and 80 to 85 percent combustible recovery. 662.6 P4

D63-6 LOW-PRESSURE PNEUMATIC STOWING

Morris, A. H. and Pentith, G. R. O., Steel & Coal 186, 171-186, 289-290 (1963). Low pressure stowing has a cost advantage over pneumatic stowing with medium or high pressure. The stowing installations and equipment at three collieries are described and information is given on costs and methods of operation. D216, D217

D63-7 BITUMINOUS COAL FINES: A LOW COST FILLER FOR RUBBER AND PLASTICS

Mueller, W., Palinchak, S., and Stickney, P. (Battelle Memorial Institute), Rubber Age 93 (2), 255-264 (1963). The characteristics of low-volatile bituminous coal fines are tabulated. They are shown to result in materials with properties generally comparable to materials made with other fillers. D257

D63-8 A NEW CRUSHER-STOWER

Steel & Coal 186, 812-813 (1963). The Brieden crusher-stower and its operation are described. D218

D63-9 DETECTION OF UNDERGROUND BURNING COAL FIRES WITH INFRARED RECONNAISSANCE EQUIPMENT

Psolka, F., Short Circuit, HRB-Singer, Inc. 13 (10), 1-2 (1963). Aerial surveys were made over an anthracite refuse bank of the Glen Alden Company using the infrared surveillance system which is a thermal sensing device that records variations in radiated energy caused by changes in surface temperatures. This method detects underground burning activity through measurements made on the surface which is warm, cold, or hot depending on conditions and locations of the underground burning. Two flights were made at night on this project. 360. 63-2

D63-10 DETECTION OF UNDERGROUND BURNING COAL FIRES WITH INFRARED RECONNAISSANCE EQUIPMENT

Psolka, F. F., Frank, J. D., and Woodbridge, C. L., HRB-Singer, Inc., Report to Pennsylvania Department of Mines and Mineral Industries, S-74 (1963). 13 pp.+ This detection method uses infrared technique to define status of burning coal refuse banks at Richmond Colliery and Hudson Coal Co. at Scranton, Pennsylvania, and Huber Colliery in Ashley-Sugar Notch near Wilkes-Barre. Large temperature variations can be detected on surface, areas can be defined and variations in temperature contours can be obtained. 360. 63-1

D63-11 WEMCO HMS AND FLOTATION AT N.C.B. BADDESLEY COLLIERY

WEMCO (Division of Arthur G. McKee & Company) - On the Job, G6-SI 11 (undated). The operation of WEMCO machinery in recovering coal is described. D269

1964

D64-1 BREAKER REFUSE - A SCENIC BLIGHT OR AN ASSET

Bellano, W. (Glen Alden Coal Co.), Coal Mining & Processing 1 (7), 23-25 (1964). The author points out that present methods of coal cleaning leave significantly less coal in the refuse than was the case with older less efficient methods. He discusses using currently produced refuse as land fill material. Chemical analysis, proximate analysis and size consist of typical refuse samples are given. 360. 64-2

D64-2 COAL SAVED, POLLUTION CONTROLLED BY GUYAN 1 FINE-COAL PLANT

Coal Age 69 (3), 87-88 (1964). This article describes the fine coal processing plant of Guyan No. 1 mine of Island Creek Coal Company, Amherstdale, West Virginia. A detailed flow sheet is included showing how water and air pollution are eliminated. Operation is meeting state requirements. Jour

D64-3 COAL WASTE PROCESSING PLANT PROFITABLY RECOVERS COAL AND BUILDING MATERIALS

Organization for Economic Co-operation and Development - Technological Digests 9 (5), 45 (May 1964). The Haldex Process for recovering coal from refuse and producing by-products useable in the construction industry is described. CE340

D64-4 LOW-COST REFUSE DISPOSAL

Dress, L., Coal Mining & Processing 1 (1), 31, 46 (1964). The coal waste slurry pipeline system of Truax-Traer Coal Company preparation plant in DuQuoin, Illinois, handles all refuse from coal washing, ash from the heat dryer and heating boiler, dust and spillage from floors, and effluent from

D64-4 (continued)

centrifugal dryers. Disposal is into refuse ponds where solids settle out and water is decanted to an adjacent pond. Pumps and piping are described and operating data and cost are listed. D282

D64-5 RECLAIMING FINE COAL FROM SETTLING PONDS

Ferney, F. X. (Bird Machine Company), Mining Congress Journal 50 (4), 48-50 (1964). The method, equipment, and costs of fine coal recovery from a slurry pond at the Banning Mine of Republic Steel Corporation are discussed. D254

D64-6 A LABORATORY INVESTIGATION OF THE PROPERTIES OF COAL-BITUMEN PAVING MIXTURES

Howard, G. G., University of Kentucky, Engineering Experiment Station, Bulletin No. 71 (March 1964). 46 pp. The principal objective of this study was to investigate the feasibility of using coal, and to a lesser extent coal mine wastes (both burned and unburned), as aggregate in bituminous paving mixtures. These Eastern Kentucky aggregates were laboratory tested in bitumen-aggregate mixtures, and, more particularly, in so-called cold-mixes. The bitumen-aggregate mixtures were evaluated by the Immersion-Compression Test, ASTM D 1075-60, with recommended modifications for cold mixtures. Among the conclusions are that all of the combinations of binders and aggregates tested lacked one or another property required in highway pavements. (Adapted from text) CE604

D64-7 CHARACTERISTICS OF REFUSE BANK MATERIALS WHICH CONTROL BURNING AND POTENTIAL USE

Lovell, H. L., Mitchell, D. R., Kindig, J. K., and Peters, J. W., AIME Annual Meeting, New York, New York, 1964. Preprint No. 64F54. 22 pp. The Penn State studies on coal refuse reviewed in this paper are characterization of refuse, combustion behavior of raw refuse, and beneficiation and utilization of refuse. 360. 64-1

D64-8 AN INVESTIGATION OF THE CYCLONE FOR FINE COAL CLEANING

Munn, K. J. and Lovell, H. L., The Pennsylvania State University, Department of Mineral Preparation, Special Research Report to Pennsylvania Coal Research Board, SR-45 (1964). 104 pp. With a three inch cyclone using only water medium to clean fine coal, ash was reduced from 26 to 14 percent with a 45 percent yield. Sulfur could not be reduced in one cyclone. Different apex orifices were used to determine maximum performance. It appears the cyclone will be most effective in a multi-stage process which will probably include other operations such as sieve bend and flotation. 662.6 P4

D64-9 PRODUCTION OF LIGHTWEIGHT AGGREGATE FROM WASHERY REFUSE

Myers, J. W., Pfeiffer, J. J., and Orning, A. A., U.S. Bureau of Mines, RI 6449 (1964). 19 pp. Work done on two refuse materials to prepare lightweight aggregate is described. The products made in a pilot sintering plant met ASTM

D64-9 (continued)

specifications. Apparatus and test procedures used are also described and test data are tabulated. BurM

D64-10 NEW SUBSIDENCE-CONTROL PROJECT IN PENNSYLVANIA ANTHRACITE REGION APPROVED BY INTERIOR DEPARTMENT

U.S. Bureau of Mines, News Release, Sept. 7, 1964. Under Public Law 87-818, a portion of the abandoned Buttonwood-Nottingham mine complex will be filled to control subsidence in Plymouth Borough, Pennsylvania. Coal breaker refuse will be introduced into the mine by blind-flushing. An example of subsidence in the borough is given. 302. 64-1

D64-11 PROPERTIES OF HYDRAULIC BACKFILLS AND PRELIMINARY VIBRATORY COMPACTION TESTS

Nicholson, D. E. and Wayment, W. R., U.S. Bureau of Mines, RI 6477 (1964). 31 pp. Field sampling of in-place densities of fills presently used in four different mines, and laboratory and underground compaction tests using a standard concrete vibrator show that the initial in-place density of the cohesionless fill material tested can be significantly increased by vibratory compaction. BurM

D64-12 PIT-HEAP PLANTS WIN COAL FROM WASTE

Colliery Guardian 208, 444 (1964). This news item describes a process developed in Hungary and used also in Poland. Material for road-building and for cement factories and brick works is produced as well as fine coal for industrial boilers. D221

D64-13 RECLAMATION OF COAL FROM PIT DIRT: A PROFITABLE METHOD OF MAKING UP COLLIERY OUTPUT

Colliery Engineering 41, 4-10 (1964). The coal recovery plant at the Baddesley Colliery, Great Britain, is described. Representative washability data are tabulated and the economics of the process are summarized. D220

D64-14 SCRANTON, PENNSYLVANIA MINE-FILLING PROJECT APPROVED

U.S. Bureau of Mines, News Release, April 9, 1964. A $1-1/4 million Federal-State project to fill mined-out areas under heavily built-up sections of Scranton is described. Some 660,000 cubic yards of crushed mine refuse will be flushed into the voids. 302. 64-1

D64-15 SURVEY OF BURNING COAL-MINE REFUSE BANKS

Stahl, R. W., U.S. Bureau of Mines, IC 8209 (1964). 39 pp. This survey includes details of 495 refuse banks in 15 states. The location, name, size, status of bank, and stage of fire are included. Methods of controlling burning refuse are reviewed. BurM

D64-16 SUCCESSFUL DEBUT OF BEIEN BREAKER STOWER

Colliery Engineering 41, 312-314 (1964). The rail-mounted machine crushes and stows debris without interfering with work at the coal face. There are water sprays for dust suppression. Where height is a problem, the breaker and stower can be separated. Experience with the machine in the National Coal Board's East Midlands District is described. D222

D64-17 AIR POLLUTION FROM COAL REFUSE DISPOSAL AREAS

Sussman, V. H. and Mulhern, J. J. (Pennsylvania Department of Health), Journal of the Air Pollution Control Association 14 (7), 279-284 (1964). The problem of air pollution from burning refuse banks is described, and methods of preventing, controlling, and extinguishing refuse fires are discussed. The development of regulations, under the authority of the Pennsylvania Air Pollution Control Act, to control refuse disposal so that refuse fires can be prevented is reviewed. Jour

D64-18 PENNSYLVANIA'S REGULATION 1: A BLOW TO AIR POLLUTION

Sussman, V. H., Coal Mining & Processing 1 (5), 32-33 (1964). Under passage of the new Regulation 1, the Air Pollution Commission is given authority to act in the cases of burning refuse piles and to require permits for operation of a disposal area. The Department of Health is to investigate each burning pile and following its report the Commission will issue orders for prompt elimination of the condition. The Regulation provides standard procedures for construction of refuse piles and these are used as a basis for issuing permits. 712.122 64-2

D64-19 UTILIZATION OF COAL REFUSE FOR THE MANUFACTURE OF LIGHTWEIGHT AGGREGATE

Utley, R. W., Lovell, H. L., and Spicer, T. S., The Pennsylvania State University, Special Research Report to Pennsylvania Coal Research Board, SR-46 (1964). 98 pp.+ The purpose of this investigation was to study the relationship between the washability fractions of coal refuse and the quality of lightweight aggregate products prepared from such refuse. Work was carried out on three samples of current refuse, each weighing three thousand pounds, and collected in such a manner that they were representative of the material actually being discarded. The 1/4 inch by 8 mesh fraction of screened material was subjected to extensive washability studies. Ten sink float separation products were subject to spectrochemical analysis for the major constituents. Ten similar sink fractions and a composite sample were fired both as a pellet and as a powder and the resulting products tested for specific gravity, percent expansion and compressive strength. The characteristics of coal refuse that contribute to making a good lighweight aggregate are identified. (From authors' summary) D14

1965

D65-1 COAL-ASSOCIATED MINERALS OF THE UNITED STATES. PART 1. PENNSYLVANIA AND MARYLAND COAL-ASSOCIATED MINERAL OCCURRENCES AND MARKETS

Bucklen, O. B., et al., West Virginia University, Coal Research Bureau, R&D Report No. 8 to U.S. Office of Coal Research (1965). (89 pp.) NTIS, PB-168 110. In the separate section for each state the information is arranged according to coal seams and includes mineral composition of the strata relating to each particular seam. Each section has a bibliography and maps showing the location of coal seams, industries, power plants, and transportation facilities. OCR W5 8

D65-2 COAL-ASSOCIATED MINERALS OF THE UNITED STATES. PART 2. OHIO COAL-ASSOCIATED MINERAL OCCURRENCES AND MARKETS

Bucklen, O. B., et al., West Virginia University, Coal Research Bureau, R&D Report No. 8 to U.S. Office of Coal Research (1965). (91 pp.) NTIS, PB-168 111. This report contains information on 20 coal seams. Limestone is the predominant mineral, together with some clay and a small amount of ore. Detailed descriptions of each seam are included and the analysis of the associated mineral is given. Market outlet information includes the transport distance and the number of industries in the counties in which the seams are mined which could use the minerals. Maps show location of the coal seams. OCR W5 8

D65-3 COAL-ASSOCIATED MINERALS OF THE UNITED STATES. PART 3. WEST VIRGINIA COAL-ASSOCIATED MINERAL OCCURRENCES AND MARKETS

Bucklen, O. B., et al., West Virginia University, Coal Research Bureau, R&D Report No. 8 to U.S. Office of Coal Research (1965). (82 pp.) NTIS, PB-168 112. In this report, 21 coal seams are described. Each listing includes analyses of the associated clay, shale, sandstone, and/or limestone. A series of maps shows the probable extent of minable reserves in each area. Other information presented is the market potential for each mineral and proximate analyses of the coals included in this part of the study. OCR W5 8

D65-4 COAL-ASSOCIATED MINERALS OF THE UNITED STATES. PART 4. SOUTHERN APPALACHIA COAL-ASSOCIATED MINERAL OCCURRENCES AND MARKETS (VIRGINIA, EASTERN KENTUCKY, TENNESSEE, ALABAMA)

Bucklen, O. B., et al., West Virginia University, Coal Research Bureau, R&D Report No. 8 to U.S. Office of Coal Research (1965). (55 pp.) NTIS, PB-168 113. This report shows that Virginia has a large coal-associated sandstone reserve, Tennessee has almost no limestone and little clay and shale, and eastern Kentucky and Alabama have both clay and shale. Stratigraphic charts show the various coal seams and associated minerals in each state and proximate analyses for the respective coal seams. Each state section has a bibliography and also maps showing locations of all seams. OCR W5 8

D65-5 COAL-ASSOCIATED MINERALS OF THE UNITED STATES. PART 5. MID-WESTERN COAL-ASSOCIATED MINERAL OCCURRENCES AND MARKETS (ILLINOIS, WESTERN KENTUCKY, INDIANA, MISSOURI, KANSAS, IOWA AND TEXAS)

Bucklen, O. B., et al., West Virginia University, Coal Research Bureau, R&D Report No. 8 to U.S. Office of Coal Research (1965). (145 pp.) NTIS, PB-168 114. Information for each state is considered in a separate section with its own bibliography and other selected references. Coal occurrence is shown on maps and market potential of various minerals is tabulated. For Illinois, Kentucky, Indiana, and Kansas, coal seams and related strata are described and proximate analyses of the coals of the various seams and amounts of minerals in the various strata are given. Coals of Missouri, Iowa, and Texas are discussed generally because there is a lack of coal seam correlation. Physical properties of Iowa clays are tabulated, as is the germanium content of a number of Kansas coals. OCR W5 8

D65-6 COAL-ASSOCIATED MINERALS OF THE UNITED STATES. PART 6. WESTERN COAL-ASSOCIATED MINERAL OCCURRENCES AND MARKETS (COLORADO, MONTANA, NEW MEXICO, NORTH DAKOTA, UTAH, SOUTH DAKOTA, WASHINGTON AND WYOMING)

Bucklen, O. B., et al., West Virginia University, Coal Research Bureau, R&D Report No. 8 to U.S. Office of Coal Research (1965). 69 pp. NTIS, PB-168 115. Information for each state shows extent of coal occurrence and related strata, mineral analyses of strata, possible commercial potential, and a list of references. The uranium content of lignites and coals is shown. OCR W5 8

D65-7 COAL-ASSOCIATED MINERALS OF THE UNITED STATES. PART 7. USES, SPECIFICATIONS AND PROCESSES RELATED TO COAL-ASSOCIATED MINERALS

Bucklen, O. B., et al., West Virginia University, Coal Research Bureau, R&D Report No. 8 to U.S. Office of Coal Research (1965). 131 pp. NTIS, PB-168 116. This extensive review consists of the following detailed sections: A. Coal-associated clays and shales; B. Coal-associated limestone; C. Coal-associated sandstone; D. Coal-associated fly ash; E. Minor coal-associated minerals; F. Miscellaneous coal-associated elements affecting coal utilization; and G. Multi-product mining and preparation with conventional methods. Each section identifies the extent, quality, and probable uses of potentially valuable minerals located above, in, and below significant coal seams of the United States. 44 References. OCR W5 8

D65-8 DENSE MEDIA PLANT PROCESSES CULM BANK MATERIAL

Hewes, R. B., Coal Mining & Processing 2 (5), 34-39 (1965). This article describes a project to recover coal from anthracite refuse by State Coal Company, Shamokin, Pennsylvania. Coal recovered averages 18-20 percent of the feed. Rejects are used as fill material for old strip pits. Pictures and detailed diagrams of the process are included. 360. 65-5

D65-9 MINUS 48 MESH REFUSE DISPOSAL AT U.S. STEEL'S GARY CENTRAL COAL PREPARATION PLANT

Hummer, E. D., Mining Engineering 17 (3), 63-66 (1965). The refuse pumping system, dam design, and impoundment practice used by United States Steel Corporation's Gary, West Virginia, preparation plant for disposal of minus 48 refuse are discussed. D274

D65-10 ANALYSES OF CLAY, SHALE AND RELATED MATERIALS--SOUTHWESTERN COUNTIES

Johnson, S. S., Denny, M. V., and Le Van, D. C., Virginia Department of Conservation and Economic Development, Division of Mineral Resources, in cooperation with U.S. Bureau of Mines, Mineral Resources Report 6 (1965). 210 pp. Three of the 120 materials sampled and tested were from coal refuse piles in Wise County. Information given includes location of the samples, type and description of material, properties, results of slow firing tests and bloating tests, and potential use. Tests indicated that material in two of the piles could be used in manufacturing sintered lightweight aggregate, and that material in the third pile could be used in making common brick. VaMRR, CE621

D65-11 REPROCESSING BITUMINOUS COAL REFUSE

Kindig, J. K. and Irons, S. D., Mining Congress Journal 51 (7), 36-39 (1965). A 50 tph refuse processing plant was built and operated on Barnes and Tucker property by Pennsylvania State University. A heavy media system was part of the process which is shown in a detailed flow sheet. The object of the program was to remove a low grade coal product from refuse thereby eliminating burning piles. D76

D65-12 USEABLE FUEL RECOVERED FROM COLLIERY WASTE

Nash, W. L. G., Coal Mining & Processing 2 (5), 40-41 (1965). The SIMDEX process, developed and used in Hungary and Poland as the Haldex process, is described. It is a hydrocyclone washery which uses the fines present in the crushed feed to form the separating medium. D306

D65-13 NEW RECLAIM-TYPE PLANT PRODUCES QUALITY COAL, PROVIDES BACK FILLING

Coal Age 70 (4), 118-122 (1965). Usable coal from old anthracite tailings (culm) banks is recovered in centrifugal and bath-type heavy media units. The reject from the process is used in filling abandoned strip-mine pits. Jour

D65-14 PENN STATE STARTS PLANT TO TEST BANK PROCESSING

Coal Age 70 (3), 29 (1965). This short article describes the 50 tph heavy-medium refuse-processing plant built by Heyl and Patterson near Barnesboro, Pennsylvania. Jour

D65-15 PROCESS MAY REDUCE POLLUTION FROM BURNING COAL REFUSE PILES

Chemical & Engineering News 43 (4), 49-50 (Jan. 25, 1965). The pilot plant described in this article was built at Barnesboro, Pennsylvania. In the process originated by H. B. Charmbury of Pennsylvania State University, high-ash coal crushed to less than 1 inch is treated in heavy media to separate coal from nonburnable waste rock. 360. 65-1

D65-16 FINE COAL RECOVERY AND MINE BACKFILL PREPARATION AT KAISER STEEL CORPORATION, SUNNYSIDE, UTAH

Shoemaker, J., Denver Equipment Company, Bulletin No. M4-B114 (undated). 8 pp. Flow sheets are shown for both the coal recovery and mine backfill preparation plants and the systems are described. Backfill is pumped into obsolete entries and worked-out areas. Water drains through burlap covering timber dams and is returned to the main sumps for reuse. D235

D65-17 THE SIMDEX WASHING PROCESS

Colliery Engineering 45, 480-482 (1965). The patented process, developed in Hungary, uses fines present in the feed to form the separating medium. A flow sheet shows the entire coal recovery process. D223

D65-18 THE PREPARATION OF COAL REFUSE FOR THE MANUFACTURE OF LIGHTWEIGHT AGGREGATE

Utley, R. W., Lovell, H. L., and Spicer, T. S. (The Pennsylvania State University), Transactions of AIME 232, 346-352 (1965). This article describes a study made using bituminous and anthracite refuse samples, separated at gravities 1.4 to 2.96. Chemical compositions were determined and aggregates were prepared in the laboratory at temperatures of 1250 to 1350 C. The fraction sinking at 2.60 gave aggregate with lowest gravity, greatest expansion and greatest compressive strength. D35

D65-19 A PILOT PLANT FOR TREATMENT OF CULM BANK MATERIAL

Walker, J. L., Jr., Heyl & Patterson, Inc., Report to Pennsylvania Department of Mines and Mineral Industries, 1965. 24 pp. This report outlines the preliminary progress made on the project to recover coal. The processing pilot plant was built on old property of Dickson Coal Company, Scranton, Pennsylvania. The report includes investigation and exploration, process design and engineering, procurement and fabrication of materials, erection and installation. 360. 65-4

D65-20 ANTHRACITE REFUSE DISPOSAL

Williams, I. L. and Stortz, A. F., Mining Congress Journal 51 (8), 33-35 (1965). In this account of Glen Alden Coal Company's disposal program, pictures show how refuse is handled and stock-piled. A list of guide lines for proper disposal is included. 360. 65-3

1966

D66-1 ABERFAN INQUIRY

"Aberfan inquiry: first week," Engineering 202, 1004-1005 (Dec. 9, 1966). "Sixth week of Aberfan inquiry," Engineering 203, 161 (Feb. 3, 1967). "Aberfan: area engineer's evidence," Engineering 203, 247 (Feb. 17, 1967). "Aberfan: new instructions on responsibilities," Engineering 203, 374-375 (March 10, 1967). "Aberfan inquiry: expert evidence," Engineering 203, 667 (April 28, 1967). "Aberfan: the technical report," Engineering 204, 208-209 (Aug. 11, 1967). These news items report the information brought out at the hearings on the disastrous coal refuse pile slide which killed 144 persons in Wales. D252

D66-2 COAL PREPARATION -- MEETING THE CHALLENGES

Coal Age 71 (9), 99-114 (1966). Discussion of inplant processes includes plant design, contributions of cyclone technology, improving coal classification, flotation, filtration, thermal and mechanical dewatering, and handling plant water. In the section on refuse handling and storage both underground and surface storage are considered. Jour

D66-3 STUDY OF SOME FACTORS IN THE FLOCCULATION OF COAL WASHERY TAILINGS

Dru, G. (Centre d'Etudes et Recherches des Charbonnages de France), Fifth International Coal Preparation Congress, Pittsburgh, Pennsylvania, by U.S. Bureau of Mines and American Mining Congress, 1966. Paper D6. pp 267-279. This paper on the removal of suspended solids from coal washery water covers various flocculants available, the operating method, and factors affecting flocculation including changes in the shale, the water and the flocculant as a function of the time, and the influence of pH and temperature. Both laboratory studies and commercial-scale use tests are reported. (Adapted from Introduction) 662.6 I927

D66-4 AN INVESTIGATION OF THE CLEANING OF BITUMINOUS COAL REFUSE FINES BY AN EXPERIMENTAL HYDROCYCLONE

Falconer, R. A. and Lovell, H. L., The Pennsylvania State University, Department of Mineral Preparation, Special Research Report to Pennsylvania Coal Research Board, SR-58 (1966). 121 pp. The objectives of the investigation were (1) to determine by statistical methods the combination of hydrocyclone dimensional parameters that yield the optimum rejection of ash and sulfur constituents to the underflow product and (2) to analyze the relative contributions made by three different cone angles to the rejection of ash and sulfur constituents to the underflow product. (From Summation of Results) 662.6 P4

D66-5 MINE BACKFILLING WITH PNEUMATIC STOWING. PART I. PNEUMATIC CONVEYING OF STOWING MATERIAL; PART II. APPLICATIONS OF STOWING

Jerabek, F. H. and Hartman, H. L., Mining Congress Journal 52 (5), 51-56, 58-60, and (6), 69-71, 76-79 (1966). Current state-of-the-art in pneumatic

D66-5 (continued)

stowing is reviewed in Part I. Particularly emphasized are design considerations and determination of system parameters. Part II deals with preparing the material, costs, the disadvantage of dust formation, and maintenance of equipment. The material handling system is critical to successful pneumatic stowing. Good performance is obtained using suitable equipment and efficient scheduling of underground operations. 302. 66-6

D66-6 PUMPING: A GOOD WAY TO DISPOSE OF COAL PLANT REFUSE

Levin, P., Coal Mining & Processing 3 (7), 30-33 (1966). This article points out the merits of pumping refuse, including low operating costs, minimum capital investment, flexibility in pumping and disposal, and elimination of dewatering units. Several plant examples and costs are given. 445.1 66-1

D66-7 THE EVALUATION OF ANTHRACITE REFUSE AS A HIGHWAY CONSTRUCTION MATERIAL

Luckie, P. T., Peters, J. W., and Spicer, T. S., The Pennsylvania State University, Department of Mineral Preparation, Special Research Report to Pennsylvania Coal Research Board, SR-57 (1966). 66 pp. Indications are that raw refuse could not be used in highways, and beneficiated refuse could only be used as embankment fill. 662.6 P4

D66-8 METHODS EMPLOYED FOR UNDERGROUND STOWING (A RESUME OF A LITERATURE SURVEY)

Luckie, P. T. and Spicer, T. S., The Pennsylvania State University, Department of Mineral Preparation, Special Research Report to Pennsylvania Coal Research Board, SR-55 (1966). 55 pp. There are 120 references in this review and discussion of the literature. 662.6 P4

D66-9 UNDERGROUND STOWING OF ANTHRACITE REFUSE FOR SURFACE SUPPORT

Maneval, D. R., Charmbury, H. B., and Lambert, R. A. (Pennsylvania Department of Mines and Mineral Industries), AIME Annual Meeting, New York, New York, 1966. Preprint No. 66F61. 9 pp. Revised and published as "Pennsylvania stows refuse to bolster abandoned coal mines," Mining Engineering 19 (4), 82-84 (1967). The case history of the project to backfill a mine of the Diamond Colliery in Scranton, Pennsylvania, is related as an example of the technique of pneumatic stowing or flushing refuse into mine voids to control surface subsidence. 302. 66-1, 67-1

D66-10 IGNITION AND CONTROL OF BURNING OF COAL MINE REFUSE

Myers, J. W., Pfeiffer, J. J., Murphy, E. M., and Griffith, F. E., U.S. Bureau of Mines, RI 6758 (1966). 24 pp. Laboratory experiments showed minus 3-1/2 inch refuse ignites spontaneously more readily than minus 1/4 inch refuse. Burning of 1,000 pound conical coal pile was controlled by capping with an 18 inch thick layer of minus 1/4 inch refuse containing 37 percent combustible material. BurM

D66-11 A PILOT PLANT FOR TREATMENT OF CULM BANK MATERIAL

Heyl & Patterson, Inc., Final Report to Pennsylvania Department of Mines and Mineral Industries, 1966. 26 pp.+ Work done to separate coal from refuse material in the anthracite region leads to the conclusion that coal can be reclaimed from many culm banks and that the secondary refuse is practically non-combustible material which can be used for fill. Pictures of the pilot plant together with process diagrams show the method used. Tabulated data are given for a number of culm materials. Each source is an individual case and must be evaluated to find out actual costs. D142

D66-12 PIT WASTE INTO LIGHTER CONCRETE

New Scientist 29 (477), 20 (1966). This Polish process uses carbonaceous shale from refuse heaps. The material is self-burning after it is ignited. The low density, high compressive strength product has good noise and heat insulation properties. D276

D66-13 PLANT COLONIZATION STUDIES ON BLACK WASTES FROM ANTHRACITE MINING IN PENNSYLVANIA

Schramm, J. R. (Indiana University), Transactions of the American Philosophical Society 56, Part 1 (1966). 194 pp. This report covers plant growth and maintenance on anthracite waste piles. It is highly descriptive and contains many pictures of various plants and root systems. 631 S377, 66-168

D66-14 SOIL EROSION OF THE SLOPES OF WASTE DUMPS BY WATER

Smolik, D. (Land Reclamation Research Station, Ostrava), Uhli No. 12, 452-453 (1966). National Coal Board Trans. A.2615. One method of preventing self-ignition of coal waste dumps is to spread a thick cover of soil over them. However, the erosion of the soil must be prevented. The amount of erosion on a covered refuse dump was measured by catching the washed-off soil and drying and weighing it. The tabulated data indicated the need for anti-erosion measures, such as proper grading and revegetation, as soon as possible. D124

D66-15 THIRD ANTI-SUBSIDENCE PROJECT APPROVED BY INTERIOR DEPARTMENT FOR PENNSYLVANIA ANTHRACITE REGION

U.S. Bureau of Mines, News Release, May 27, 1966. The project for controlling subsidence in Coaldale, Pennsylvania, is announced. Blind flushing and land fill with coal refuse is planned. Subsidence in the area is described. 302. 66-2

D66-16 INVESTIGATIONS OF THE CYCLONE WASHING OF FINE COAL IN WATER

Weyner, L. H. E. and Lovell, H. L., The Pennsylvania State University, Department of Mineral Preparation, Special Research Report to Pennsylvania Coal Research Board, SR-61 (1966). 271 pp. Three major aims of the work were: 1. the analysis of the pressure requirements of a wide angle cyclone with relatively high solid-to-pulp ratios of the feed; 2. the analysis of the

D66-16 (continued)

flow ratio of such cyclone; 3. an investigation of the separation of a typical fine coal according to the recovery of solids in the apex product, the rejection of ash and sulfur, and the response from particle density. (From Summary) 662.6 P4

1967

D67-1 THE ABERFAN REPORT

The Engineer 224, 179-181 (Aug. 11, 1967). This is an abstract of part V of the report which discusses the causes of the disastrous flow-slide of the refuse; and a reprint of the findings and summary of the report. D252a

D67-2 EASTERN COAL PELLETIZES TO RECOVER FINES, STEM POLLUTION

Mining Engineering 19, 24 (Sept. 1967). Fine coal is recovered by froth flotation from the cleaning plant effluent at the Stone, Kentucky, plant of Eastern Coal Corporation. The coal filter cake is blended with a binder and then pelletized. D270

D67-3 PELLETIZING FINE COAL RECOVERED FROM PUMPED REFUSE

Egan, H. N., AIME Fall Meeting, Rocky Mountain Minerals Conference, Las Vegas, Nevada, Sept. 6-8, 1967. Preprint No. 67F307. 8 pp. Also published in Mining Engineering 19 (11), 73-75 (1967). Eastern Coal Corporation, Stone, Kentucky, found that 80 percent of their fine coal refuse could be recovered at an acceptable ash content. Since the fine coal had completely different characteristics from the cleaned coal product it required separate handling. The pelletizing plant that prepares a product suitable for shipping is described. The problems encountered in the shake down period of operation are discussed. D225, 440.6 67-1

D67-4 GUIDELINES FOR THE APPROVAL OF TIP-HEAPS SET UP WITHIN THE AREA ADMINISTERED BY THE MINE (EXTRACTS)

Ministerialblatt für das Land Nordrhein Westfalen, 1967. pp 168-192. National Coal Board Translation A.2697/AGR. Criteria for refuse pile construction are summarized. D233

D67-5 RECOVERY OF PYRITES FROM COAL REFUSE--A PILOT PLANT STUDY

Lovell, H. L. (The Pennsylvania State University, Department of Mineral Preparation), AIME Fall Meeting, Rocky Mountain Minerals Conference, Las Vegas, Nevada, Sept. 6-8, 1967. Preprint No. 67F351. 12 pp. Lower Kittanning seam refuse was processed in a heavy media cyclone plant constructed at Barnes and Tucker Coal Company to investigate the possibility of pyrite recovery as a source of sulfur. Washability and sulfur recovery data are tabulated and show the difficulty of achieving adequate separation of pyrite. 440. 67-5

D67-6 PELLETIZING MAKES WASTE PAY OFF

The Iron Age 199, 82 (June 15, 1967). The plant built by Eastern Coal Corporation to recover and pelletize fine coal is described. D238

D67-7 THE EFFECT OF SELECTED CALCINING TEMPERATURES ON ALUMINA EXTRACTION FROM COAL ASSOCIATED DRAW-SLATE

Shafer, H. E., Jr. and Solomon, J. A. (West Virginia University, Coal Research Bureau), Transactions of AIME 238, 101-103 (1967). Also published as West Virginia University, Coal Research Bureau, Technical Report No. 23 (undated). 9 pp. Work has been done on coal related material to find the optimum temperature for calcination which would give maximum extraction of alumina by sulfuric acid. The material was pulverized, calcined, leached with acid, and the product precipitated as aluminum sulfate. Pulverizing was to minus 30 mesh and calcining temperatures ran from 100 to 700 C. Details of results are discussed. Calcining at about 500 C seems most favorable for alumina extraction. Jour, 662.6 W521

D67-8 THAT REFUSE PILE MAY BE A TREASURE TROVE

Coal Mining & Processing 4 (8), 59-60, 62 (1967). Amigo Smokeless Coal Company has added a preparation plant to its Wyco, West Virginia, facility. Plant operation includes processing refuse and middlings from fine coal air tables. The coal produced by heavy media separation and froth flotation is a high grade metallurgical product with less than five percent ash and less than one percent sulfur. The process units and equipment are described. The thickener underflow is sent into old mine workings. 440.3 67-4

D67-9 POLLUTION CONTROL IN MINING AND PROCESSING OF INDIANA COAL

Woodley, R. A. and Moore, S. L., J. Water Pollution Control Federation 39, 41-49 (1967). Graphs show coal production, number of active mines, and annual acreage disrupted and reclaimed. A map gives the stream miles affected by mine drainage. Quality of drainage from a coal refuse site is tabulated. Jour

D67-10 RECOVERING SULFUR AND IRON FROM COAL PYRITES

Zimmerman, R. E. and Roman, G. H., Coal Age 72 (4), 60-71 (1967). This very comprehensive article gives refuse analyses, pyrite products and recovery history, describes pyrite roasting methods, and gives acid manufacturing process diagrams. Data also include theoretical pyrite yields from plant refuse and recovery from high sulfur coals. A detailed pyrite processing diagram is included. Jour

1968

D68-1 ZETA POTENTIAL CONTROL: ITS APPLICATION IN COAL PREPARATION

Baker, A. F. and Miller, K. J. (U.S. Bureau of Mines), Mining Congress Journal 54 (1), 43-44 (Jan. 1968). The theory of zeta potential and its measurement

D68-1 (continued)

are described. Bureau of Mines work has demonstrated that lowering the zeta potential of very fine refuse will aid in settling it. The authors also discuss other uses of zeta potential in relation to refuse, such as aiding in the choice of flocculant to be added to coal refuse slurry, and in showing how pyrite depressants function. Jour

D68-2 MAINTENANCE OF REFUSE DISPOSAL AREAS

Beerbower, R. C., Jr., Coal Age 73 (2), 102-106 (1968). At U.S. Steel's Maple Creek Mine, New Eagle, Pennsylvania, refuse was spread in layers using a slope of 1:1 or 1:2 depending on terrain. The slopes were covered with about 10 inches of clay before planting. White, Austrian and red pine seedlings were planted on slopes and face of the slurry pond dam. Jour

D68-3 AVOIDING POLLUTION FROM REFUSE DISPOSAL

Calhoun, F. P. (Rochester & Pittsburgh Coal Company), Mining Congress Journal 54 (6), 78-80 (1968). Following a few fundamental rules in building the refuse pile can keep the pile from causing a pollution problem as well as from becoming an eyesore after it is abandoned. This account of the Rochester & Pittsburgh Coal Company disposal program includes pictures of the disposal area. Jour

D68-4 CONTROL OF REFUSE DISPOSAL POLLUTION

Calhoun, F. P. (Rochester & Pittsburgh Coal Company), American Mining Congress Coal Convention, Pittsburgh, Pennsylvania, 1968. 4 pp. The paper describes a method of building a new refuse pile so that it will not cause pollution. 68-74

D68-5 EXTINGUISHMENT OF MINE WASTE FIRE AT ISELIN, PENNSYLVANIA

Carr, B. B., Callery Chemical Company Monthly Report No. 1 to Pennsylvania Department of Mines and Mineral Industries, Feb. 1968. 13 pp. Work planned by the company in extinguishing a burning mine dump on the property of Rochester and Pittsburgh Coal Company is described. Grading and temperature surveys are planned first followed by sealing techniques such as by polyurethane foam or soil solidification. 310.3 68-2

D68-6 SUBSIDENCE CONTROL IN THE ANTHRACITE FIELDS OF PENNSYLVANIA

Charmbury, H. B., Smith, G. E., and Maneval, D. R., ASCE Annual Meeting and National Meeting on Structural Engineering, Pittsburgh, Pennsylvania, Sept. 30-Oct. 4, 1968. Preprint 721. 22 pp. Work has been done on three projects in the Scranton and Pittston, Pennsylvania, areas to stabilize abandoned and worked-out mines. Methods of hydraulic stowing either as "blind flushing" or as "controlled flushing" are described. D236

D68-7 FIRE EXTINGUISHING AGENT

Cooper, W. J. and Kyilonen, D. M. (to Callery Chemical Company, Pittsburgh, Pennsylvania), U.S. Patent 3,367,863 (Feb. 6, 1968). 2 pp. A slurry of very fine solids, made by heating together aluminum acid phosphate and a source of boron oxide, is sprayed on burning refuse piles. The water evaporates on contact with the hot surface and leaves a foamed continuous hard coating that fills cracks and deep crevices and thus prevents the pile from re-igniting. USPat

D68-8 WASTE TIP STABILIZATION IN THE RUHR

Corner, J. T. (Dollery and Palmer, Ltd.), Colliery Guardian 216, 250-253 (1968). This article describes in detail the methods used in the Ruhr for constructing and landscaping coal mine refuse piles. 68-189

D68-9 RESPONSE OF CROWNVETCH PLANTED ON ANTHRACITE BREAKER REFUSE

Czapowskyj, M. M., Mikulecky, J. P., and Sowa, E. A., U.S. Department of Agriculture, Northeastern Forest Experiment Station, Forest Service Research Note NE-78 (1968). 7 pp. The objective of the study was to see if crownvetch could be established on coal-breaker refuse by seeding or planting crowns and using several lime, fertilizer, and mulch treatments. Details of the seeding and planting procedures are outlined and measurements made at end of each growing season are tabulated. Refuse material had pH values ranging from 2.7 to 4.0, and was extremely low in fertility with negligible amounts of organic matter. Study showed that lime is essential in order for crownvetch to grow. Fertilizer had little effect. Lime effects reported here were short-term effects. Since pyrite content of the refuse was high it was felt that lime effects might disappear when the pH reverts to its former level. D45

D68-10 COAL WASTE BANK STABILITY

Davies, W. E., Mining Congress Journal 54 (7), 19-24 (1968). This article describes in detail the physical characteristics of coal waste piles, their composition and reasons for stability. Considerable detail is included on locations of waste banks, particularly concerning causes of avalanches. Most of the information pertains to the conditions in the Appalachian area where many hillside dumps are located on very weak foundations. D69

D68-11 USE OF UNBURNT COLLIERY SHALE AS FILLING MATERIAL IN EMBANKMENTS

Downie, W., Ministry of Transport, Engineering Intelligence Division, Great Britain, Technical Memo. T4/68, E.Int.4/7/01 (Sept. 5, 1968). 2 pp. Conclusions from studying the use of coal refuse are presented and the recommendation is made that refuse should be accepted as road-building material for a trial period of several years. Recommendations are also made for adjustments to contracts when refuse is planned to be used, and for calling on the engineering experience of the National Coal Board and the Road Research Laboratory. CE819

D68-12 FIRE FIGHTING CONTRACTORS LEVEL MOUNTAINS OF BURNING COAL WASTE

Construction Methods 50, 64-67 (March 1968). Two contractors used different methods, described in detail, to extinguish refuse bank fires in the anthracite region of Pennsylvania. In one case the contractor cut down the bank with draglines, scrapers, and dozers, using jet streams of water to extinguish the fire. In the other case, the contractor bored horizontal holes into the bank, shot it, soaked it with water, and then dozed it away. D226

D68-13 ECONOMIC IMPACT OF AIR AND WATER POLLUTION CONTROL ON COAL PREPARATION

Frankel, R. J. (Resources for the Future, Inc.), Mining Congress Journal 54 (10), 56-63 (1968). This article emphasizes closed water circuits in coal preparation and also refers to dry cyclones for dust control. Discussion on cost estimates indicates difficulty in obtaining realistic figures. Washability data are included for many coals. Jour

D68-14 TECHNOLOGIC AND ECONOMIC INTERRELATIONSHIPS AMONG GASEOUS, LIQUID, AND SOLID WASTES IN THE COAL-ENERGY INDUSTRY

Frankel, R. J. (Resources for the Future, Inc.), J. Water Pollution Control Federation 40, 779-788 (1968). Two examples are given to show that waste production and waste handling alternatives must be considered in an economic analysis of overall production costs. Jour

D68-15 DEWATERING COAL FLOTATION TAILING BY THE ADMIXTURE OF CRUSHED WASHERY REFUSE

Geer, M. R., Jacobsen, P. S., and Sokaski, M., U.S. Bureau of Mines, RI 7110 (1968). 15 pp. The mineralogical composition of different refuse materials determines their ability to retain water. Particle size influences water holding capacity of refuse in which kaolinite and silica predominate. BurM

D68-16 GUIDES FOR OPERATING COAL REFUSE DISPOSAL AREAS UNDER AIR POLLUTION COMMISSION REGULATION I

Pennsylvania Department of Health, Air Pollution Commission (undated, obtained 5/24/68). 4 pp. The refuse disposal procedures cover site selection and preparation, pile construction, trouble-shooting, and silt ponds and banks. 717.338 68-1

D68-17 REFUSE MULCH BOOSTS TOMATO YIELD

Hawk, C. O., Friedman, S., McCullough, E. B., and Hiteshue, R. W., Coal Age 73 (6), 90-94 (1968). This article describes the use of coal washery refuse as mulch to treat 100 tomato plants. One to two inches in 3 ft diameter around each plant increased output up to 30 percent in peak of season. Soil preparation, planting, and cultivating details are given. Jour

D68-18 REFUSE REMOVAL AND DISPOSAL

Hummer, E. D. and Vogel, L. J., in "Coal Preparation," J. W. Leonard and D. R. Mitchell, Eds., New York: AIME, Seeley W. Mudd Series, 1968. pp 16-1 - 16-37. This thorough discussion covers refuse storage, belt conveyors, aerial tramways and truck disposal, as well as hydraulic handling and disposal of fine refuse. 622.6 M681

D68-19 A SURVEY OF THE LOCATION, MAGNITUDE, CHARACTERISTICS AND POTENTIAL USES OF PENNSYLVANIA REFUSE

Peters, J. W., Spicer, T. S., and Lovell, H. L., The Pennsylvania State University, Special Research Report to Pennsylvania Coal Research Board, SR-67 (1968). 180 pp. This survey shows the location and estimated contents of refuse banks in Pennsylvania. Included are 157 culm banks containing more than 451 million tons of refuse with an estimated content of 113 million tons of recoverable coal and 113 silt banks containing 63 million tons of recoverable coal. Samples obtained from each of the four major anthracite fields were analyzed for size, washability, and chemical characteristics. Studies carried out to develop uses for coal refuse are also reviewed. 662.6 P4

D68-20 COAL SPOIL HEAPS: SITE INVESTIGATION AND STABILITY ANALYSIS

Smith, G. N. (Heriot-Watt University, Edinburgh), Colliery Guardian 216 (5583), 585-586 (1968). The author discusses the surveys of new sites and existing refuse heaps, sampling of refuse material, and stability analysis. Standard techniques of soil mechanics can determine within reasonable limits present stability of a refuse heap, but there is little knowledge available as to how to predict long term stability. D227

D68-21 SPOIL TIP MANAGEMENT

National Coal Board, Great Britain, Revised Edition, Feb. 1968. 71 pp. This report contains examples of tip and lagoon failures and their causes. A section discusses coal preparation and refuse. Information on technical and operational control of spoil tips is extensive, with many diagrams illustrating subsidence factors, stability, and rock slip problems. D87

D68-22 FLOTATION RECOVERY OF PYRITE FROM BITUMINOUS COAL REFUSE

Sun, S. C. and Savage, K. I. (The Pennsylvania State University), Transactions of AIME 241, 377-384 (1968). This process, designed to recover coal, clays, and pyrite from coal wastes, consists of fine grinding followed by coal and pyrite flotation which leaves the clays in the flotation pulp. A coal refuse containing 10% sulfur and 30% carbonaceous material was treated by this method to yield a coal product containing 4% sulfur, 10% ash; a pyrite product containing 45% sulfur (84% FeS_2), 1% carbonaceous material; and a clay product 2% sulfur (3.5% FeS_2). The coal yield was about 84%. The pyrite yield was about 77%. (From authors' abstract) D152

D68-23 THE ECONOMIC FACTORS OF MINERAL WASTE UTILIZATION

Vogely, W. A. (U.S. Bureau of Mines), Proceedings of the First Mineral Waste Utilization Symposium, Chicago, Illinois, by U.S. Bureau of Mines and IIT Research Institute, 1968. pp 7-19. Anthracite and bituminous coal mine wastes are among the wastes discussed. The amounts of wastes generated, conservation issues, and social costs are some of the factors considered. 622 M6

D68-24 THE EFFICIENCY OF PNEUMATICALLY STOWED FACES IN THE GERMAN, FRENCH AND BELGIAN COALMINING INDUSTRY

Voss, K. H., Glückauf, July 4, 1968. p 609. National Coal Board Translation A.2715/HSH. Different mining conditions in the various areas lead to different mining practices. The advantages and disadvantages of caving and pneumatic stowing are discussed. A number of ways to improve the efficiency of pneumatic stowing, revealed by a 1967 survey of 80 faces in these three countries, are discussed. D232

1969

D69-1 WASHERY DISCARD IN DIKE AND EMBANKMENT CONSTRUCTION

Annen, G. and Stalmann, V., Glückauf 105 (26), 1336-1343 (Dec. 25, 1969). National Coal Board, TRANS.A.2794/AL Several types of refuse from mines in Germany were studied to determine how their characteristics would affect their use in dike and embankment construction. Petrographic structures of refuse samples were examined and measurements were made of particle sizes. Also studied were water absorption by clays in refuse, behavior of refuse under compaction, shear strength and water permeability of refuse embankments, spontaneous ignition of refuse used in construction, and formation of high sulfate leachates from the refuse. CE360

D69-2 COAL RECLAMATION FROM WASTE HEAPS

Mining & Minerals Engineering 5 (4), 41-42 (1969). The Alexander Russell Group at Gartshore, Dunbartonshire, England plans to reclaim spoil tip material adjacent to a former Gartshore Colliery. The pile contains 2,600,000 tons and will require six years to process. The waste material will be converted to lightweight aggregate by the same firm and several sizes of reclaimed coal will be sold. D170

D69-3 COLLIERY SHALE - A NEW SOURCE OF BULK CONSTRUCTION MATERIAL

Mining & Minerals Engineering 5 (6), 11 (June 1969). The use of unburnt colliery shale as bulk fill at the International Hoverport at Pegwell Bay, Ramsgate, England, is described. CE334a

D69-4 WASTE DISPOSAL COSTS AT TWO COAL MINES IN KENTUCKY AND ALABAMA

Danielson, V. A. and White, D. H., U.S. Bureau of Mines, IC 8406 (1969). 28 pp. Costs of the existing waste disposal systems at each mine were

D69-4 (continued)

estimated using present-day costs of equipment and labor. Costs of waste disposal systems using alternate equipment were also estimated. Although total disposal costs were essentially the same for both operations, reclamation costs will differ because of different reclamation practices. (From authors' abstract) BurM

D69-5 PREPARATION PLANT WATER CONTROL AND REFUSE DEWATERING SYSTEMS

Emmett, R. C., Jr. and Dahlstrom, D. A., Mining Congress Journal 55 (12), 32-40 (1969). Preparation plant water circuits are as critical as the beneficiation flowsheet in influencing results, yields, capital, and operating costs. This detailed article includes process diagrams and shows all phases of material handling. Emphasis is on economical ways to provide clean water. Jour

D69-6 DISPOSAL OF SOLID WASTES FROM COAL MINING IN WASHINGTON, OREGON, AND MONTANA

Geer, M. R., U.S. Bureau of Mines, IC 8430 (1969). 39 pp. Location, amount, character, and condition were determined, and both economic and environmental factors were considered. Areas covered by waste comprise 800 acres in Washington, 5 acres in Oregon, and 1,200 acres in Montana. In a few cases waste is being utilized, particularly cinder from burned refuse dumps, as fill in road construction and as a ceramic raw material. (From author's abstract) D92

D69-7 UTILIZATION OF COAL DUST SLURRIES

Hollinger, R. H., The Franklin Institute Research Laboratories, Technical Report to U.S. Bureau of Mines, Contract 14-09-0070-380, Feb. 1967 - June 1969. 26 pp.+ This work was done to evaluate the use of 100 mesh coal dust as a partial replacement for sand in making concrete blocks. Improvement in water resistance resulted and acceptable compressive strengths were obtained. Much of the batch equipment would not work with the coal formula so hand work was required. An extensive economic study, included as Appendix II, discusses the cost of grinding the coal product and screening. The economic study limited coal haulage distance to 45 miles. D28

D69-8 MODERN APPROACH TO PLANT REFUSE DISPOSAL

Hummer, E. D. (U.S. Steel Corporation), Coal Age 74 (6), 75, 76, 81 (1969). This article outlines requirements for an efficient disposal system. Diagrams show stacking, contouring, and compacting practices. A section is also included on handling fine refuse. Jour

D69-9 CONSOLIDATION COAL COMPANY'S ACHIEVEMENTS IN ENVIRONMENTAL CONTROL

Karkaria, N. J. (Consolidation Coal Company), Mining Congress Journal 54 (9), 46-51 (1969). Pictures of the Pocahontas Fuel Division's reclamation program

D69-9 (continued)

at the Lynco Preparation plant area show stages of the restoration including views of the refuse dump before reclamation, grading in progress, terracing and planting. Similar projects at Harmar Mine and Pittsburgh Coal Company plant near McMurray, Pennsylvania and the Cadiz area of Hanna Coal are described. Jour

D69-10 CEMENT STABILISED UNBURNT COLLIERY SHALE

Kettle, R. J. and Williams, R. I. T. (University of Surrey, England), Roads and Road Construction 47, 200-206 (July 1969). Samples of refuse from three collieries were used in these studies. The physical properties of the shales and their compaction characteristics when mixed with cement were determined. Also reported are values for compressive strength, tensile strength, modulus of elasticity, and resistance to immersion. Although the unburnt refuse shows promise for use in road construction, one of the conclusions of the study is that the results of the tests on the three materials vary so much that no refuse material should be used without being thoroughly tested. CE349

D69-11 A METHOD FOR DETERMINING THE PARTITION CURVE OF A COAL WASHING PROCESS

Luckie, P. T., Spicer, T. S., and Lovell, H. L., The Pennsylvania State University, Department of Mineral Preparation, Special Research Report to Pennsylvania Coal Research Board, SR-70 (1969). 159 pp. This work was done to develop statistically a partition curve of a coal working process. The original data is determined by float and sink tests giving the various separation figures which are then used in a computer analysis. 662.6 P4

D69-12 RECENT ADVANCES IN EXTINGUISHMENT OF BURNING COAL REFUSE BANKS FOR AIR POLLUTION REDUCTION

Maneval, D. R. (Pennsylvania Department of Mines and Mineral Industries), ACS Division of Fuel Chemistry Preprints 13 (2), 27-41 (1969). The history of the problem of burning coal banks is presented. A number of different techniques are discussed and it is noted that because of variation of conditions from bank to bank varying success is obtained with different methods of fire control. ACS 51F

D69-13 PENNSYLVANIA ANTHRACITE REFUSE: A SURVEY OF SOLID WASTE FROM MINING & PREPARATION

McCartney, J. C. and Whaite, R. H., U.S. Bureau of Mines, IC 8409 (1969). 77 pp. The Bureau of Mines surveyed refuse banks in the anthracite area of Pennsylvania and found 863 banks occupying a total area of about 19 square miles. Most of these were located within 2 miles of the traffic centers of communities having a population of 625,000. Twenty-seven banks are burning, causing considerable distress in certain communities. Many tables, maps, and diagrams outline the scope of this survey. BurM

D69-14 OPERATION RED DOG. A STUDY OF FLUID-BED COMBUSTION AND POTENTIAL USES OF ANTHRACITE CULM-BANK MATERIAL

Dorr-Oliver Inc., R&D Report 42 to U.S. Office of Coal Research and Pennsylvania Department of Mines and Mineral Industries (undated, Period of Performance Aug. 1966 - April 1969). 118 pp. This report presents results and conclusions of bench-scale fluid-bed combustion of anthracite refuse for removal of carbon and sulfur from the solid residue. The calcined refuse was tested for use as material in highway construction and brickmaking. A schematic pilot plant layout is presented consisting of crushing, screening, fluid-bed combustion, dust collection and gas scrubbing equipment for a 0.5 tph operation. Economic evaluation of an envisioned commercial refuse-combustion brickmaking facility is presented, based on use of a single 32 ft ID fluid-bed reactor for combustion of 735 tpd of 17 percent carbon anthracite refuse. Possible use of Marvine culm-bank anthracite refuse in soil-bituminous construction and Taylor culm-bank calcined refuse as soil-cement have been indicated by exploratory testing. Extraction and economic recovery of such minor constituents as germanium, lithium, vanadium, and uranium, and a major constituent, alumina do not appear feasible at present. (From author's abstract) OCR D7

D69-15 PEGWELL BAY HOVERPORT UTILISES UNBURNT COLLIERY SHALE

Civil Engineering and Public Works Review 64, 606-607 (June 1969). Coal refuse was used to replace soft mud and silt on the bay side of the Hoverport. The placement of this material, in conjunction with an area of broken concrete, serves to protect the paved areas of the Hoverport. Burnt refuse is used as base material under the landing area and access ramps. CE334

D69-16 CONTROL OF POLLUTION FROM COAL MINE REFUSE SITES AND SLURRY PONDS

Ramsey, J. P. (Truax-Traer Coal Company), AIME Fall Meeting, Salt Lake City, Utah, Sept. 17-19, 1969. Preprint No. 69-F-330. 4 pp. The demonstration project near DuQuoin, Illinois, where a refuse site and slurry lagoon will provide basic data for water pollution control and refuse pile reclamation, is described. AIME

D69-17 THE SCOTS ARE THRIFTY

Singhal, R. K., Coal Mining & Processing 6 (12), 45-47 (1969). In processing colliery waste at the Gartshore plant near Twechar northeast of Glasgow, Scotland, coal and a usable shale are recovered. The shale is used in an adjoining plant in manufacturing lightweight aggregate and building blocks. Dense media processing results in sharp separation of shale and coal. A detailed flow diagram is given. D239

D69-18 UNDERGROUND DISPOSAL OF SLURRIED WASTES

Stinson, D. L., University of Wyoming, College of Engineering, Natural Resources Research Institute, Report to U.S. Bureau of Mines, April 1969.

D69-18 (continued)

22 pp. This report describes underground injection using slurries of sand and of clay. It is suggested that coal preparation plant wastes might also be disposed of by this method. D40

1970

D70-1 A METHOD FOR EXTINGUISHING AND REMOVING BURNING COAL REFUSE BANKS

Andreuzzi, F. C., U.S. Bureau of Mines, IC 8485 (1970). 29 pp. The most effective method used in the demonstration project was water quenching to a workable depth, then ripping and removing quenched material. BurM, D36

D70-2 UTILIZATION OF COAL MINING WASTES

Charmbury, H. B., in Proceedings of the Second Mineral Waste Utilization Symposium, Chicago, Illinois, by U.S. Bureau of Mines and IIT Research Institute, 1970. pp 225-227. In this presentation, the author discusses previous handling of coal refuse, present practice, and the future of refuse disposal. 622 M6

D70-3 COAL MINES WITHOUT WASTE HEAPS. UNDERGROUND STOWING METHOD IN POLAND

Mining and Minerals Engineering 6 (7), 12 (1970). At the Brzeszcze mine in Poland, worked out sections are being filled from waste heaps of rock so that the surface heaps are diminishing instead of increasing as more coal is mined. A new machine is used to crush the rock and pneumatically stow it. Waste material from processing and coal washing plants is also disposed of this way by the equipment which operates underground. D161

D70-4 COLLIERY SHALE AS A ROADMAKING MATERIAL

Ministry of Transport, Road Research Laboratory, Crowthorne, Berkshire, Great Britain, Leaflet LF 154, C.EF.31 (Feb. 1970). 2 pp. The effects of various characteristics on the use of burnt and unburnt coal refuse materials as road-building material are discussed. CE818

D70-5 COLLIERY SHALES

Great Britain, National Coal Board (undated). 12 pp. This brochure is intended to inform those responsible for highway and other construction of the suitability and availability of coal refuse for use as a construction material in various projects. CE820

D70-6 U.K. PLANT INTEGRATES LIGHTWEIGHT AGGREGATE WITH BLOCK

Cook, P. B., Rock Products 73, 64-66 (1970). The integrated operation of Aglite Ltd., Twechar, Dunbartonshire, Scotland, is described. Coal is reclaimed from an old refuse dump and the residue is processed into lightweight aggregate which is used at the same site for production of concrete blocks. D271

D70-7 A THERMOPHILIC ACIDOPHILIC MYCOPLASMA ISOLATED FROM A COAL REFUSE PILE

Darland, G. (1), Brock, T. D. (1), Samsonoff, W. (2), and Conti, S. F. (2) [(1) Indiana University and (2) University of Kentucky], Science 170, 1416-1418 (1970). This paper deals with the discovery of a thermophilic acidophilic procaryote lacking a cell wall which has been found in a coal refuse pile. The organism was able to reproduce by budding. Temperature optimum was found to be 59 C. Growth occurs over a range of 45 to 62 C. No growth occurs at 37 or at 65 C. Optimum pH for growth is between 1 and 2. (From authors' abstract) D103

D70-8 AN APPRAISAL OF THE UTILIZATION POTENTIAL OF COLLIERY WASTE

Gibson, J., Mining & Minerals Engineering 6 (11), 28-29, 32-33, 42 (1970). The uses described are those in highway construction, in making skid resistant road surface dressing, as concrete or lightweight aggregate, in mineral wool, and as binder and filler for plastics. Fluidized combustion is discussed as a method of disposing of colliery waste. D228

D70-9 MINING AND MILLING WASTE DISPOSAL PROBLEMS - WHERE ARE WE TODAY?

McNay, L. M. (U.S. Bureau of Mines), Proceedings of the Second Mineral Waste Utilization Symposium, Chicago, Illinois, by U.S. Bureau of Mines and IIT Research Institute, 1970. pp 125-130. Coal refuse disposal is one of the waste problems discussed. Bank stability, air pollution, land use conflict, and coal recovery are reviewed in detail. The four references all are on coal refuse. 622 M6

D70-10 LIQUID CARBON DIOXIDE USED TO EXTINGUISH A GOB FIRE IN A GERMAN COAL MINE

Rice, G. S. and Hartmann, I., U.S. Bureau of Mines, IC 6970 (Nov. 1970). 5 pp. A method of extinguishing a mine fire in a refuse filled area in a German mine is described. The report first appeared in Glückauf p. 383, April 24, 1937. Liquid carbon dioxide under high pressure was forced into the gob. BurM

D70-11 OPERATION ANTHRACITE REFUSE

Spicer, T. S. and Luckie, P. T. (The Pennsylvania State University, Department of Mineral Preparation), in Proceedings of the Second Mineral Waste Utilization Symposium, Chicago, Illinois, by U.S. Bureau of Mines and IIT Research Institute, 1970. pp 195-204. This paper describes Operation Anthracite Refuse, a research assault seeking to establish approaches and capabilities for utilizing and/or disposing of anthracite refuse by determining the characteristics, methods of beneficiation and economic value of current and in site refuse. It covers the initial phase of the research program upon this major solid material waste problem facing northeastern Pennsylvania, discussing the history, nature, magnitude, and potential solutions to the problem. (Authors' abstract) 622 M6

D70-12 SPOIL HEAPS AND LAGOONS

National Coal Board, Great Britain, Technical Handbook, Second Draft, Sept. 1970. 232 pp. Technical information presented provides the background for government regulations concerning the establishment and maintenance of refuse disposal areas. Factors affecting refuse pile stability and causing refuse pile fires are discussed in detail. Directions are given for reclaiming refuse disposal areas and for designing and constructing new refuse disposal sites and lagoons. D96

D70-13 SOLID MINERAL WASTES--BLIGHT OR BONANZA?

Stearn, E. W., Rock Products 73 (6), 78-79, 96 (June 1970). The papers given at the Second Mineral Waste Utilization Symposium, held March 18-19, 1970, are reviewed. Papers relating to coal refuse material are abstracted in the Coal and Environment Bibliographies. CE585

D70-14 UTILIZATION OF MINING AND MILLING WASTES

Sullivan, G. D., in Proceedings of the Second Mineral Waste Utilization Symposium, Chicago, Illinois, by U.S. Bureau of Mines and IIT Research Institute, 1970. pp 215-219. Coal wastes are one of the mining and mineral wastes discussed. 622 M6

D70-15 PREVENTION OF ACID MINE DRAINAGE: SILICATE TREATMENT OF COAL MINE REFUSE PILES

Walitt, A., Jasinski, R., Keilin, B., and Gruber, A. (Tyco Laboratories, Inc.), Third Symposium on Coal Mine Drainage Research, Pittsburgh, Pennsylvania, by Coal Industry Advisory Committee to ORSANCO, 1970. 17 pp. This paper is based on studies carried out for EPA, Water Quality Office, and published as "Silicate Treatment for Acid Mine Drainage Prevention," Water Pollution Control Research Series 14010 DLI 02/71. 70-109

D70-16 ANTHRACITE REFUSE AS AN AGGREGATE IN BITUMINOUS CONCRETE

Wenger, M. E. and Schmidt, G. H., Pennsylvania Department of Highways, Bureau of Materials, Testing & Research, Bituminous Section, Research Project No. 70-8, June 1970. (22 pp.) The anthracite refuse used in this study was considered not to be suitable for use in roadway surface material, but possibly suitable for shoulder and subbase construction. Two characteristics of the material led to this conclusion: refuse pieces had a coating of fine powdery material which impeded the coating of the refuse with the asphaltic mortar; and large particles tended to fracture during stability tests. CE401

D70-17 BROILER LITTER ON WELSH COAL TIPS

White, C., Agriculture 77 (2), 49-51 (Feb. 1970). The author describes studies in which poultry manure was used as a fertilizer in establishing grasses on coal refuse disposal areas. CE957

1971

D71-1 THERMAL PROPERTIES OF COAL-CLEANING WASTES

Agroskin, A. A., Goncharov, E. I., and Yakunin, V. P., Coke and Chemistry, U.S.S.R., No. 7, 8-11, 1971. This article evaluates coal cleaning wastes by measuring thermophysical properties of coal wastes, determining maximum effective specific heat values, and other thermal characteristics such as thermal conductivities. Jour

D71-2 METHODOLOGY FOR THE CHARACTERIZATION OF ANTHRACITE REFUSE

Augenstein, D. and Sun, S. C., The Pennsylvania State University, Department of Mineral Preparation, Special Research Report to Pennsylvania Department of Environmental Resources, SR-86 (1971). 77 pp. The object of this work was to develop the methodology necessary for examining the physical and compositional characteristics of anthracite coal refuse with the aid of a device to remove organic material at temperatures well below 200 C without altering the original minerals; sample and analyze refuse from the several old banks in the anthracite region and from two operating plants; and to examine the nature of occurrence of minerals in refuse by analysis of different size and gravity fractions. (From Introduction). 662.6 P4

D71-3 POLLUTION CONTROL OF PREPARATION PLANT WASTES - - A RESEARCH AND DEMONSTRATION PROJECT

Barthauer, G. L. (Consolidation Coal Company), AIME Environmental Quality Conference, Washington, D.C., June 7-9, 1971. Paper EQC 38. 14 pp. This project was carried out at the New Kathleen Mine in southern Illinois to demonstrate a practical way to abate pollution from coal mine preparation plant wastes. The refuse pile covered approximately 40 acres and the slurry lagoon, about 50 acres. The rate of acid formation was determined and remedial procedures were investigated. 71-80

D71-4 CONTROL OF MINE DRAINAGE FROM COAL MINE MINERAL WASTES. PHASE I -- HYDROLOGY AND RELATED EXPERIMENTS

Barthauer, G. L., Kosowski, Z. V., and Ramsey, J. P., Truax-Traer Coal Company, Report to U.S. EPA, Office of Research and Monitoring, Water Pollution Control Research Series 14010 DDH 08/71 (1971). 148 pp. NTIS, PB-206 194. The characteristics and acid formation rate of a refuse pile covering 40 acres are reported. A number of vegetative covers were used and evaluated for reducing acid pollution. D115

D71-5 FIRES IN COAL MINING WASTES: A REVIEW OF CAUSES, PROCEDURES, LEGISLATION AND POLLUTION

Campbell, A. R., Proceedings of Australian Waste Disposal Conference, 1971. Paper No. 17. pp 87-92. Among the subjects discussed are the influence of mining and marketing methods on amount of refuse, prevention and control of refuse fires, and regulation of refuse disposal of New South Wales, Great Britain, and Pennsylvania. D328

D71-6 BEAUTIFICATION OF ANTHRACITE REFUSE

Charmbury, H. B., Bergman, E. L., and Chubb, W. R. (The Pennsylvania State University), AIME Annual Meeting, Feb. 21, 1971. 14 pp. In the program conducted to find ways to revegetate anthracite refuse piles, poultry manure was used as successfully as lime fertilizer. Kentucky B1, creeping fescue, and in some cases crownvetch were hydroseeded on anthracite spoil bank material, refuse banks, silt basin refuse, and incinerated refuse. Mulch was used in some cases. Only one plot did not support germination and growth and it was assumed that the particle size of the soil was too large to retain moisture well. D122

D71-7 CROSSFLOW SCREENS, CYCLONES, AND CENTRIFUGES

Coal Mining & Processing 8 (9), 52-55 (1971). This article describes the preparation facilities and material handling procedures at the Universal mine of Peabody Coal Company. The plant gets maximum recovery of both clean coal and refuse down to 1/4 mm size in jig washing. The refuse slurry circuit and other equipment in the preparation plant are described. R134

D71-8 COLLIERY WASTE DISPOSAL PROBLEMS

Currie, G. A., Barnsley and District Mining Society Transactions 22, 47-52 (1971-72). The preparation of a code of practice for the construction of spoil heaps and lagoons is discussed. D58

D71-9 DEMONSTRATION OF A TECHNIQUE FOR LIMITING THE SUBSIDENCE OF LAND OVER ABANDONED MINES

Candeub, Fleissig and Associates, Technical Report to U.S. Department of Housing and Urban Development, June, 1971. 65 pp.+ NTIS, PB-212 708. This report gives the detailed description of the Rock Springs, Wyoming, area and the demonstration of the closed system hydraulic backfill developed by Dowell Division of Dow Chemical Company. D359

D71-10 PRELIMINARY REPORT OF WATER QUALITY MEASUREMENTS AND REVEGETATION TRIALS ON MINED LAND AT LUSCAR, ALBERTA

Etter, H. M., Canadian Forestry Service, Northern Forest Research Centre, Edmonton, Alberta, Internal Report NOR-3, Aug. 1971. 19 pp. This report concerns a project around the Camp, Cabin, and Luscar Creeks in the Upper Foothills of western Alberta, Canada. The project involved water sampling and testing in addition to a revegetation by hydroseeding on weathered sandstone and shale overburden. Five seed mixtures were used and a tabulation gives the grasses and legumes and their maximum expected number of germinants. Several sketches and diagrams show the location and position of the test areas. A detailed tabulation of the water sample analyses is also given. Sediment, including coal particles, was also monitored. 71-107

D71-11 THE PREVENTION AND CONTROL OF BURNING IN WASTE COAL DUMPS

Flann, R. C. and Lukaszewski, G. M. (CSIRO, Division of Mineral Chemistry), Proceedings, Australian Institute of Mining and Metallurgy No. 238, 11-29 (June 1971). Under Australian conditions the technique recommended for control of existing dump fires, based on experimental work, is to spray the dump with a chemical fire retardant, to cover the dump with a suitable soil, and to seal the surface with a 1 percent solution of aluminum sulfate or sodium metasilicate. The recommended method of dump construction to prevent fires is to level and seal the site, to construct a firebreak around the dump area, and to build a rectangular dump with minimum size segregation and compacted surfaces. (From authors' abstract) D255

D71-12 COAL MINE REFUSE DISPOSAL IN GREAT BRITAIN

Glover, H. G. (Visiting Professor of Mineral Science), The Pennsylvania State University, Special Research Report to Pennsylvania Department of Environmental Resources, SR-81 (1971). This report describes types of refuse, disposal methods, utilization of refuse, and current research. 662.6 P4

D71-13 CRUSHING ANTHRACITE REFUSE

Greenlee, J. K. and Spicer, T. S., The Pennsylvania State University, Department of Mineral Engineering, Special Research Report to Pennsylvania Department of Environmental Resources, SR-87 (1971). 67 pp. The purpose of this study was to determine how much it costs to crush anthracite refuse to sizes that can be used. The scope has been limited to size reduction from 3 feet to 1/2 inch which is considered primary and secondary crushing. The effects on the costs of the characteristics of material to be crushed and the crusher used have also been investigated. 662.6 P4

D71-14 THAT REFUSE DISPOSAL PROBLEM

Jones, D. C., Coal Mining & Processing 8 (10), 42-49 (1971). This is a survey of methods used in the collection of preparation plant refuse and covers disposal by trucks, conveyors, aerial tramways, and hydraulic methods. Problems associated with storage piles as well as their economic potential are also discussed. R135

D71-15 LANDSCAPE RECLAMATION: A REPORT ON RESEARCH INTO PROBLEMS OF RECLAIMING DERELICT LAND

Research Team, University of Newcastle upon Tyne, IPC Science and Technology Press Ltd., Guildford, Surry, England, Vol. 1, 1971. 135 pp. Vol. 2, 1972. 85 pp. Most of the material in these volumes deals with reclaiming coal refuse piles. The problem in Great Britain is outlined and details of a number of specific projects are reported. Drainage, revegetation, removal and/or regrading of refuse piles, legal aspects, and costs of the work are all considered. D430

D71-16 CARBONATE BONDING OF COAL REFUSE

LaRosa, P. J., Karnavas, J. A., and Pelczarski, E. A., Black, Sivalls & Bryson, Inc., Report to U.S. EPA, Water Quality Office, Water Pollution Control Research Series 14010 FOA 02/71 (1971). 44 pp. Both bituminous and anthracite refuse were treated with water and lime hydrate and carbon-dioxide rich gas to form a material which was tested for feasibility as a construction material and as a coal refuse pile sealant. D104

D71-17 STUDY OF SULFUR RECOVERY FROM COAL REFUSE

LaRosa, P. J. and Michaels, H. J., Black, Sivalls & Bryson, Inc., Report to U.S. EPA, Water Quality Office, Water Pollution Control Research Series 14010 FYY 09/71 (1971). 67 pp. NTIS, PB-203 488. A feasibility study was made on a process producing sulfur from coal refuse. Limestone and coal refuse were ground, pelletized, and preheated before entering a desulfurizing shaft reactor which produced a hard, fired ash pellet and H_2S-SO_2 bearing off gas. After sulfur, tar and other gases are removed, the H_2S-SO_2 gas goes to a conventional sulfur recovery plant. 71-59

D71-18 PENNSYLVANIA CLEANS UP ITS ANTHRACITE FIELDS

Maneval, D. R., Mining Engineering 23, 57-60 (1971). The author compares operations of anthracite mining in early days with the regulated practices of the present day. Several methods used to extinguish refuse bank fires are also described. D277

D71-19 INVESTIGATION OF THE HALDEX (SIMDEX) PROCESS FOR BENEFICIATING COAL REFUSE: HUNGARIAN PRACTICE - 1969

McLean, D. C., Kogelmann, W. J., and Spicer, T. S., The Pennsylvania State University, Department of Mineral Preparation, Special Research Report to Pennsylvania Department of Environmental Resources, SR-80 (March 31, 1971). 30 pp. On a field trip to Tatabanya, Hungary, information was obtained on the Haldex (Simdex) Process for recovering fine coal from refuse. This heavy media process, which uses a specially designed horizontal cyclone, is illustrated by flow sheets. Fine coal recovery plants in the United States and Great Britain are also described. 662.6 P4

D71-20 COAL REFUSE FIRES AN ENVIRONMENTAL HAZARD

McNay, L. M., U.S. Bureau of Mines, IC 8515 (1971). 50 pp. Bureau of Mines located and examined 292 burning coal refuse banks throughout the nation's coal-producing regions in 1968. These coal waste fires extending over 3,200 acres produce poisonous, acrid gases and particulate matter that pose a threat to health and safety in the surrounding areas. Methods of extinguishing coal refuse fires are discussed and an approach to eliminating future occurrences of these fires is presented. (From author's abstract) BurM

D71-21 A PRELIMINARY INVESTIGATION OF SLUDGE REFUSE FROM INDIANA COAL MINES

Miller, L. V. (Indiana Geological Survey), Proceedings of the Indiana Academy

D71-21 (continued)

of Science 81, 246-250 (1971). Seven samples of fine refuse (sludge) were collected from two coal mine refuse pits located in Green and Sullivan Counties. Particle size distribution and proximate and ultimate analyses of the sludge refuse were determined. The data indicated that the Btu content of the refuse was about 75 percent of that of the "whole coal" on the moisture-free basis but was almost similar on the moisture-ash free basis. (From author's abstract) D332

D71-22 MINE REFUSE PILE COVERINGS TO REDUCE WATER PERCOLATION

MSA Research Corporation, Summary Report to Pennsylvania Environmental Resources Administration, 1971. 32 pp. Five materials were evaluated as potential mine refuse pile covers: urethane foam, polyethylene sheeting, linseed oil, fly ash, and polyvinyl chloride. These materials were placed on refuse piles and checked for weathering and water permeability over a 15 month test period. D79

D71-23 NCB (PRODUCTION) CODES AND RULES - TIPS, FIRST DRAFT

National Coal Board, Great Britain, 1971. 82 pp. This publication contains the regulations pertaining to the handling and recording of refuse material in England. The contents are as follows: I. Introduction; II. General Regulations Relating to Tips; III. Regulations Relating to Active Classified Tips; IV. Regulations Relating to Closed Classified Tips; V. Regulations Relating to Resumption of Tipping Operations at Closed Tips; VI. Miscellaneous Regulations; and VII. NCB Requirements for Unclassified and Disused Tips. The appendix contains regulations for reporting tip inspections. D89

D71-24 ECTOMYCORRHIZAL ESTABLISHMENT AND SEEDLING RESPONSE ON VARIOUSLY TREATED DEEP-MINE COAL REFUSE

Nicholas, A. K. and Hutnik, R. J., The Pennsylvania State University, School of Forest Resources, Special Research Report to Pennsylvania Department of Environmental Resources, SR-89 (1971). 121 pp. In greenhouse tests, European white birch and red pine were grown with three different bituminous spoils, three levels of fungal symbiont, two levels of lime treatment, and two levels of fertilization. The results are promising enough to encourage further studies, especially field plantings. Application of fertilizer, and of lime where needed, is recommended with any plantings on refuse banks. 662.6 P4

D71-25 UTILIZATION OF COLLIERY WASTE IN THE BUILDING AND CONSTRUCTION INDUSTRIES AND IN AGRICULTURE

Nicholson, S. R., Mining & Minerals Engineering 7 (3/4), 27-28 (1971). This paper was given at the National Meeting of the Minerals Engineering Society at Nottingham University, Sept. 1970. Utilization of colliery waste in England has always been of some interest in agriculture and building and construction industries. The various uses come under the following headings (1) utilization in its natural form, (2) utilization of burnt shale, and (3)

D71-25 (continued)

utilization in manufactured building materials. The article describes in considerable detail how the materials are used and gives many examples. D120

D71-26 SILICATE TREATMENT FOR ACID MINE DRAINAGE PREVENTION

Tyco Laboratories, Inc., Report to U.S. EPA, Water Quality Office, Water Pollution Control Research Series 14010 DLI 02/71 (1971). 94 pp. NTIS, PB-198 427. Laboratory study was carried out on actual mine refuse to evaluate the effectiveness of silicate-based gels to prevent acid drainage from coal mine refuse piles. Alumina-silica gel, applied so that the gel penetrated the pile up to 6 inches, was most effective. Acid drainage formation was retarded by neutralization by the treatment materials as well as by coating of the pyritic refuse. However, treatment of acid mine water by sodium silicate and sodium aluminate was no more effective than conventional lime treatment. Although weathering tests showed that the gels were affected by extremes of temperature, washings of weathered test materials showed that residual alumina and silica maintained effectiveness for an equivalent of 120 inches of rainfall. 71-9

D71-27 PENNSYLVANIA ANTHRACITE REFUSE. A SUMMARY OF A LITERATURE SURVEY ON UTILIZATION AND DISPOSAL

Spicer, T. S., The Pennsylvania State University, Special Research Report to Pennsylvania Coal Research Board, SR-79 (1971). 43 pp. The literature references are divided into thirteen categories, each introduced by a discussion of the subjects covered. 662.6 P4

D71-28 PENNSYLVANIA ANTHRACITE REFUSE - A LITERATURE SURVEY ON CHEMICAL ELEMENTS IN COAL AND COAL REFUSE

Sun, S. C., Vasquez-Rosas, H., and Augenstein, D., The Pennsylvania State University, Special Research Report to Pennsylvania Department of Environmental Resources, SR-83 (1971). 72 pp. The purpose of this work was to learn the composition of anthracite refuse and the possible extraction of some components as an aid to refuse disposal. The 245 references pertain to all ranks of coal. 662.6 P4

D71-29 CONSTRUCTION USES FOR COLLIERY SPOIL

Tanfield, D. A. (National Coal Board, Great Britain), Reprinted from Contract Journal, Jan. 14 and 21, 1971. 4 pp. The uses of coal refuse in Great Britain described here include brick and cement making, processing into lightweight aggregate, as subsurface and road building material, and as land fill. CE822

D71-30 ENVIRONMENTAL CHARACTERISTICS AFFECTING PLANT GROWTH ON DEEP MINE COAL REFUSE BANKS

Thompson, D. N. and Hutnik, R. J., The Pennsylvania State University, School of Forest Resources, Special Research Report to Pennsylvania Department of

D71-30 (continued)

Environmental Resources, SR-88 (1971). 81 pp. This study revealed all the environmental problems which afflict plants and other vegetation on refuse banks. Slopes are steep, unstable, of varied texture, which is coarse and unable to hold satisfactory moisture. Surface temperatures are usually above the critical temperature 122 F. Chemical analyses show extreme nutrient deficiencies and toxic levels of aluminum and iron. Although nitrogen was present it was in forms not available to plants. 662.6 P4

D71-31 COAL REFUSE, BY-PRODUCTS MEDIA FOR FLORAL CROPS

White, J. W., Science in Agriculture 19 (1), 8-9 (Fall 1971). In a two year study, there was some preliminary indication that media prepared from anthracite coal refuse were beneficial for growing Red American Beauty Roses. CE761

1972

D72-1 COAL MINE SPOIL AND REFUSE BANK RECLAMATION WITH POWERPLANT FLY ASH

Adams, L. M., Capp, J. P., and Gillmore, D. W. (U.S. Bureau of Mines), in Proceedings of the Third Mineral Waste Utilization Symposium, Chicago, Illinois, by U.S. Bureau of Mines and IIT Research Institute, 1972. pp 106-111. The field treatments of surface mine spoil in a long-range combination field and greenhouse study are emphasized. Benefits of reclaiming both surface-mine spoil and coal-mine refuse include partial neutralization of acid spoil and refuse materials; increase in moisture-holding capacity and pore space of moisture-holding materials; yields of forage that compared favorably with yields from undisturbed pastures and fields; use of large amounts of fly ash. Information tabulated includes composition of fly ash used, chemical analysis of surface mine spoil at treated sites, and costs of reclamation. 662 M6

D72-2 REPORT ON VEGETATION OF COAL MINE REFUSE

Balsinger, T. R. (Silviculturist, Ebensburg, Pennsylvania), Letter to Pennsylvania Department of Environmental Resources, Environmental Quality Control Board, Nov. 15, 1972. 3 pp. Two reports are attached to this letter. In one, "Mine refuse-experimental planting plots," 2 pp., the preparation of two plots of refuse with lime, fertilizer, and seed is described. One plot was treated with an acid sensitive chemical sealer and one was not. The other report, "Coal mine refuse disposal seeding project," 2 pp., discusses the sealer and methods of applying it. Pictures in color show the difference in vegetation. D61

D72-3 RECLAIMING AN UNSIGHTLY REFUSE PILE

Barthauer, G. L., Parks and Recreation 7 (2), 25, 36 (1972). The reclamation of the refuse disposal area at the New Kathleen Mine, DuQuoin, Illinois, is described. CE297

D72-4 ENVIRONMENTAL ACTION PROGRAMS FOR NORTHEASTERN PENNSYLVANIA: REFUSE BANK REMOVAL, SUBSIDENCE MONITORING

Bee, R. W., et al., MITRE Corporation, Technical Report to U.S. Bureau of Mines, MTR-6165 (April 1972). 227 pp.+ NTIS, PB-214 535/7. The refuse removal task consisted of developing a methodology for selecting the most economical combinations of coal mine breaker refuse and rock banks, disposal sites, and material moving systems. To prepare plans for moving refuse in the Lackawanna Valley, refuse banks were inventoried, underground disposal sites identified, and unit cost data prepared for the various material moving systems. The subsidence monitoring task consisted of defining the phenomenon of coal mine induced surface subsidence, establishing operational requirements, cataloguing sensors and techniques to detect and measure subsidence, and testing of the most promising of these techniques. (From authors' abstract) 631 M684

D72-5 BUFFALO CREEK (W. VA.) DISASTER, 1972

Senate Hearings - Part 1, Appendix A; Part 2, Appendixes B, C, and D, 1972. 2717 pp. The contents include verbatim testimony of witnesses, formal statement, and related publications giving additional information. Hearings

D72-6 BUFFALO CREEK BRINGS NEW REQUIREMENTS

Coal Age 77 (4), 18, 20, 22 (1972). This article describes details of a report filed by the U.S. Department of Interior, investigating the Buffalo Creek disaster. Recommendations say each mine or plant should file a 10-20 year plan of its waste disposal systems. Jour

D72-7 THE BUFFALO CREEK DISASTER

Coal Age 77 (3), 40 (1972). This news item with a picture describes the Buffalo Creek dam failure, February 26, 1972. Jour

D72-8 THE UTILIZATION OF INCINERATED ANTHRACITE MINE REFUSE AS ANTI-SKID HIGHWAY MATERIAL

Charmbury, H. B. (1) and Maneval, D. R. (2) [(1) The Pennsylvania State University and (2) Appalachian Regional Commission], in Proceedings of the Third Mineral Waste Utilization Symposium, Chicago, Illinois, by U.S. Bureau of Mines and IIT Research Institute, 1972. pp 123-129. Anthracite refuse material from piles which had been burning was crushed, screened, and tested as a highway anti-skid material. Tests were conducted on all kinds of roads and satisfactory performance resulted. This project was an outgrowth of the State's efforts to extinguish many of the burning anthracite refuse piles in northeastern Pennsylvania. The State is now developing a specification for this product which will then place it on the bidders' lists. The specific test material was prepared from the 13 million ton refuse bank of the Huber Colliery at Ashley, Pennsylvania. 622 M6

D72-9 COAL MINING COMPANY BUILDS NEW LAND FROM REFUSE PILES

Coal Age 77 (4), 118-119 (1972). This article describes Bethlehem Mines Corporation land reclamation near the community of Idamay, Marion County, West Virginia. The company now owns 100 acres of which 60 acres are revegetated and leveled land that was formed from a refuse pile. D56

D72-10 COLLIERY SHALE IMPORTED FOR M.18 THORNE BY-PASS EMBANKMENT

Contract Journal, pp 22-23, June 29, 1972. The roadway was constructed upon an embankment built on the low-lying land which has a high water table. The road construction is described and it is noted that about half the material forming the embankment is unburnt coal refuse from the Hatfield Colliery. CE821

D72-11 CONSOL CLEANING UP COAL REFUSE PILES

Consol News 11 (1), 6-7, 9 (May-June 1972). Reclamation at the Pocahontas Fuel Company Division is described and illustrated. D351

D72-12 SUPPRESSION AND PREVENTION OF FIRES IN COAL REFUSE HEAPS

Cudmore, J. F. and Cremer, L., Australian Coal Industry Research Laboratories, Ltd., P.R. 72-4, June 1972. 32 pp.+ This report summarizes experimental work carried out to suppress an active heating in a portion of a refuse dump at a location in the South Maitland Coal Field of New South Wales. Both heat dissipation and fire suppression were achieved at the test site by employing the principle of evaporative cooling. This effect was accomplished by pumping water into sub-surface hot zones through a system of probes inserted into the dump for this purpose. Additional treatment included the capping of the smoke emission zone by a layer of ash and clinker produced on-site and surface spraying to reduce the concentration of gaseous pollutants. (From authors' summary) 662.6 A9

D72-13 DEEP COAL MINING AND THE ENVIRONMENT

Currie, W. J. (National Coal Board), Colliery Guardian Annual Review, 56-64, Oct. 1972. The present situation in British coal mining is reviewed, including handling of coal refuse and reclaiming of land by removal of refuse piles. Jour

D72-14 A DAM IN NAME ONLY BLAMED FOR DISASTROUS FLOOD

Engineering News Record 188 (9), 10 (1972). This is an account of the Buffalo Creek Dam failure as described by the U.S. Corps of Engineers who had the job of repairing much of the creek damage. D49

D72-15 WEST VIRGINIA'S BUFFALO CREEK FLOOD: A STUDY OF THE HYDROLOGY AND ENGINEERING GEOLOGY

Davies, W. E., Bailey, J. F., and Kelly, D. B., U.S. Geological Survey, Circular 667 (1972). 32 pp. This report covers the geographic and geologic

D72-15 (continued)

setting of the coal refuse dams and slurry ponds on Buffalo Creek, the history of mining and refuse disposal in the area, sources of water causing the flooding, and eyewitness accounts of the event. It was concluded that coal waste dam No. 3, which caused the flooding, failed because of generally inadequate design and instability of the refuse material. CE386

D72-16 METHOD OF SUBSIDENCE AND ACID ENTRAINED DRAINAGE CONTROL AND ADMIXTURES THEREFOR

Davis, W. A. (to Michael L. Vongrey, Jr., Kittaning, Pennsylvania), U.S. Patent 3,704,594 (Dec. 5, 1972). 9 pp. One of the materials used in formulations listed to fill mine voids is coal mine refuse. 72-70

D72-17 DISASTER ON BUFFALO CREEK 1972

Report of the Citizens' Commission Investigation, 1972. 31 pp. The Citizens' Commission is made up of a number of people who were concerned that the public investigation of the Buffalo Creek disaster would be biased and so carried out their own inquiry. The membership is listed in the brochure. The Commission's findings and conclusions are presented with notes on their supportive evidence. The recommendations made include a number for citizen action as well as for government and coal company action. In the final section it is noted that Buffalo Creek raises a basic question--"whether the ownership and operation of the coal mines should be brought under democratic control to benefit all the people." D20

D72-18 UTILIZATION OF COAL MINE REFUSE

Doyle, F. J. and Chen, C. Y. (Michael Baker, Jr., Inc.), Public Hearing on Coal Disposal Regulations, Pennsylvania Department of Environmental Resources, Environmental Quality Board, Harrisburg, Pennsylvania, Nov. 15, 1972. 14 pp. Some of the technological developments making possible utilization of large volumes of coal refuse, particularly as material in engineering construction and as a source of low cost fuel for power generation, are reviewed. The situation in Great Britain, where coal refuse is beginning to be widely used, is contrasted with the existing construction specifications in the United States which more or less prohibit the use of coal refuse. D105

D72-19 ENVIRONMENTAL PROTECTION - A CONSOL OBJECTIVE SINCE 1948

Coal Age 77 (10), 122-138 (1972). The overall mine drainage, reclamation, and waste disposal program of Consolidation Coal Company is described. Fifteen water treatment plants are in operation and three more in development stages. Major projects for the company include Ittman preparation plant, Hanna Coal Company Division's reclamation program, The Pocahontas Fuel Company reclamation project, and Dents Run surface and water cleanup. Two maps show the extent of the areas improved. Costs of each project are included. Jour

D72-20 FAILURE OF COAL WASTE EMBANKMENT BLAMED ON LACK OF ENGINEERING

Engineering News Record 188 (10), 11-12 (1972). This article describes the dam at Buffalo Creek and the events which occurred before it failed. A one-foot spillway, constructed when the water level rose near the top of the dam, was viewed as adding to the dam's instability. D48

D72-21 RECLAMATION OF SPOIL AND REFUSE BANKS WITH POWERPLANT FLY ASH

Gillmore, D. W. and Capp, J. P., AIME Annual Meeting, San Francisco, California, Feb. 20-24, 1972. Preprint No. 72-F-61. 17 pp. This paper describes the merits of fly ash as a soil conditioner for use in mined-land reclamation work. The U.S. Bureau of Mines surface-mine reclamation program from 1965 through 1971 is summarized. A number of projects in which fly ash was blended with gob-pile material or spoil to achieve neutral soil are described and the physical and chemical benefits to the soil are listed. A cost study for this kind of reclamation produced a figure of $300/acre depending on a number of factors. AIME

D72-22 VARIOUS WAYS TO RECOVER COAL FINES

Halvorsen, W. J. (Consolidation Coal Company), Coal Mining & Processing 9 (10), 49, 71-72 (1972). Current practice in recovering coal fines at three plants of Consolidation Coal Company is described. Jour

D72-23 RECLAMATION FROM COAL MINE WASTE DUMPS

Hambleton, G. C., CIM Bulletin 65 (722), 83-93 (1972). This thorough coverage of the factors involved in recovery of coal from refuse describes projects in Canada, England, and Wales. There is an extensive bibliography. Jour

D72-24 ANTHRACITE REFUSE POLLUTION AND SOCIO-ECONOMIC PLANNING IN NORTHEASTERN PENNSYLVANIA

Larkin, R. P., Peters, G. L., and Spicer, T. S., The Pennsylvania State University, Department of Mineral Engineering, Special Research Report to Pennsylvania Department of Environmental Resources, SR-90 (1972). 80 pp. This study was made to determine a plan for removing refuse piles in the anthracite region. The area is divided into four separate sections each of which is described and rated by classifying each pile according to its degree of ugliness and pollution contribution. A priority sequence for refuse bank removal was then developed. Most of the data on the refuse banks came from studies by the Bureau of Mines and the Department of Mines and Mineral Industries of the Commonwealth of Pennsylvania. 662.6 P4

D72-25 SOME PROPERTIES OF SOUTH WALES COLLIERY DISCARDS

Lawrence, J. A., Colliery Guardian 220 (6/7), 270-278, 329-333 (1972). Chemical composition, physical characteristics, and particle size distribution of a number of coal refuse materials are reported. Jour, CE627

D72-26 LIST OF COAL WASTE BANKS

U.S. Department of Interior, Task Force to Study Coal Waste Hazards, June 15, 1972. (Supersedes listing dated May 1, 1972.) 288 pp. The list identifies 960 banks located within 20 states and gives size of each bank, its specific site, the owner, the size of any impoundment, and notes if it is burning. D329

D72-27 SITUATION REPORT ON BUFFALO CREEK

Lowman, S. G., Coal Age 77 (4), 124-131 (1972). A map shows route of flooding from Buffalo Creek dam failure. Regulations now in effect and investigations in progress are reviewed. The terrain and damage from the flooding are illustrated. D57

D72-28 COAL MINING VS. ENVIRONMENT: A RECONCILIATION IN PENNSYLVANIA

Maneval, D. R., Appalachia 5 (4), 10-40 (1972). Coal refuse banks in Pennsylvania, problems related to them, and work toward solving the pollution they engender are all described. D337

D72-29 COARSE COAL CLEANING AT MONTEREY NO. 1 PREPARATION PLANT

Manwaring, L. G., Mining Congress Journal 58 (3), 42-48 (1972). This Monterey Coal Company preparation plant is committed to building and operating in a manner consistent with good environmental control purposes and to be a "good neighbor." Pictures and process diagram show how efficient and attractive this installation is and the extensive effort expended to maintain proper refuse handling and water clarification. D70

D72-30 EFFECT OF A SURFACE BOREHOLE ON LONGWALL GOB DEGASIFICATION (POCAHONTAS NO. 3 COALBED)

Moore, T. D., Jr. and Zabetakis, M. G., U.S. Bureau of Mines, RI 7657 (1972). 9 pp. The use of a partially slotted 6.5-inch-inside-diameter vertical pipe to remove methane from a longwall gob area at a depth of 2,260 feet in the Pocahontas No. 3 coalbed was investigated. The value of gas removed by such a pipe under free-flow conditions was found to equal the cost of the installation in this case. Approximately 25 percent of the available methane passed through the pipe without the use of an exhauster; an additional 10 percent was removed when an exhauster was employed. The diversion of methane through a vertical slotted pipe to the surface permitted the use of increased mining rates and decreased the ventilation air requirements. (Authors' abstract) BurM

D72-31 ROCK REMOVAL METHODS IN COAL MINES

Murray, R. E. (North American Coal Corp.), Mining Congress Journal 58 (10), 57-61 (Oct. 1972). The methods used at Oneida Mining Co., a subsidiary of North American Coal Corp., in Johnstown, Pennsylvania, are described. A completely separate rock removal and handling system has been designed and includes two standard drum-type continuous miners, two special rock-cutting

D72-31 (continued)

miners, two shuttle cars, three articulated battery scoop tractors, two locomotives to be used in tandem, 15 mine cars, rotary dumper, hopper, feeders, and crushing and conveying facilities. Jour, CE651

D72-32 EFFECTIVE FILTRATION OF SHALE SLURRIES USING ROTARY VACUUM FILTERS. 1. SELECTION OF VACUUM FILTER TYPE FOR DEWATERING FLOCCULATED COAL FLOTATION TAILING SLURRIES - AN EXPERIMENTAL APPROACH

Osborne, D. R. and Robinson, H. Y., Filtration & Separation 9 (4), 397-401, 415 (July-Aug. 1972). At the University of Newcastle upon Tyne, research on dewatering coal shale having a high clay content has been carried out using rotary vacuum filters. D111

D72-33 EVALUATION OF WASTE WATERS FROM PETROLEUM AND COAL PROCESSING

Reid, G. W. and Streebin, L. E., Oklahoma University, Norman Research Institute, Report to U.S. EPA, Office of Research and Monitoring, Environmental Protection Technology Series EPA-R2-72-001 (Dec. 1972). 205 pp. The handling and disposal of water from coal preparation is one of the concerns of this report. 72-68

D72-34 REVIEW OF RESEARCH ON PROPERTIES OF SPOIL TIP MATERIALS

National Coal Board: Headquarters Research Project, Wimpey Laboratories Ltd., Hayes, Middlesex, England, Lab. Reference No. S/7307 (Jan. 1972). (217 pp.) Testing on coarse material from 11 collieries was carried out to determine its stability in refuse piles. Shear strength was investigated extensively including the effect of moisture content and an assessment of the extent and effect of particle size degradation by mechanical breakdown and by weathering. Information on fine material discarded as slurry or tailings was obtained at 8 lagoons. A wide range of crust conditions was found, with all lagoon deposits being soft in the upper few metres, and one being extremely soft throughout. Since coarse particles tended to build up near the inlet of lagoons a recommendation was made to move the inlet from time to time to increase the stratification of the deposit to improve drainage. D347

D72-35 USE OF WASTE MATERIAL FOR ROAD FILL

Scowen, R. T. and Dewar, I. S., Joint Circular, Department of the Environment Circular 47/72, Welsh Office Circular 22/72, Great Britain (June 1, 1972). 2 pp. Appendix, STATEMENT BY LORD SANFORD ON THE USE OF WASTE MATERIAL FOR ROAD FILL House of Lords, Official Report 325 (8), Columns 687-690 (Nov. 17, 1971). 2 pp. This Circular expresses Government policy encouraging the use of coal refuse in highway construction and the possibility of crediting bids, which include the use of refuse, with the reduction of cost of reclaiming any refuse piles from which construction material is taken. CE817

D72-36 A GROWING PROBLEM: FINE REFUSE HANDLING

Sisti, D. C. (Heyl & Patterson, Inc.), Coal Mining & Processing 9 (10), 41-43 (1972). In recovering coal fines various combinations of froth flotation, static thickening, continuous vacuum filtration, solid bowl centrifuging, and flocculation are used. Jour

D72-37 STREAMLINED REFUSE DISPOSAL

Coal Age 70 (3), 106-108 (1972). This article describes Eastern Associated Coal Corporation's new refuse disposal system at its Kopperston Preparation Plant. Twin engine trucks, conveyor belts, and a 7-foot diameter steel connecting tube handle 6000 tpd. Jour

D72-38 THE GEOTECHNICAL CHARACTERISTICS OF A SPOIL HEAP AT YORKSHIRE MAIN COLLIERY

Taylor, R. K. and Spears, D. A., Quarterly Journal of Engineering Geology 5, 243-263 (1972). The physical and mechanical properties of samples from two boreholes indicate that there is no weathering of refuse below a depth of about 3 m which represents the limit of shallow percolation. D144

D72-39 TENTATIVE DESIGN GUIDE FOR MINE WASTE EMBANKMENTS IN CANADA

Wright Engineers Limited, Golder, Brawner & Associates Limited, Ripley, Klohn & Leonoff International Limited, prepared for Canada, Department of Energy, Mines and Resources, Mines Branch Mining Research Centre, Technical Bulletin TB145 (March 1972). 217 pp. The guide gives suggestions for dealing with the many parameters affecting the disposal of mine wastes in piles, embankments and settling ponds. Maintenance and reclamation of refuse disposal sites are also discussed. D322

D72-40 OXIDATION OF PYRITES IN CHLORINATED SOLVENTS

Troy, J. C., Boros, J. A., and Brenneman, D. R., Cyrus Wm. Rice Division of NUS Corporation, Report to U.S. EPA, Office of Research and Monitoring, Environmental Protection Technology Series EPA-R2-72-069 (Nov. 1972). 51 pp. NTIS, PB-214 455. The purpose of this study was to develop methods for extracting sulfur and iron compounds from pyrite waste materials thereby producing a refuse which will not cause water pollution. Primary method under investigation was the chlorination of pyrites in non-aqueous solvents. Successful extraction was obtained using continuous addition of chlorine to the system. (From authors' abstract) D84

D72-41 THE UTILIZATION OF ANTHRACITE REFUSE AS A SOILLESS MEDIUM

White, J. W., Chubb, W. R., and Charmbury, H. B. (The Pennsylvania State University), AIME Fall Meeting, Birmingham, Alabama, Oct. 18-20, 1972. Preprint No. 72-B-339. 10 pp. Also published as "Anthracite refuse as a soilless medium," Mining Engineering 25 (3), 48-49 (1973). In a project supported in part by Pennsylvania Department of Environmental Resources and the U.S. Bureau of Mines, incinerated anthracite refuse was used as a soilless

D72-41 (continued)

medium for growing greenhouse plants. Peat moss and solutions of fertilizer were added in varying amounts. Roses, azaleas, and African violets were among the plants successfully grown. D324, D341

D72-42 APPRAISAL OF STREAM SEDIMENTATION IN THE SUSQUEHANNA RIVER BASIN

Williams, K. F. and Reed, L. A., U.S. Geological Survey, Water-supply Paper 1532-F (1972). 24 pp.+ The report indicates that one reason for a down-trend in sedimentation in the main stem of the Susquehanna River is the decline of anthracite coal mining and processing in the area. D102

1973

D73-1 GOB PILE STABILIZATION IN GREAT BRITAIN

Akers, D. J., Jr. and Lawrence, W. F., West Virginia University, Coal Research Bureau, Report No. 95 (undated). 8 pp. This review of British work is based mainly on the second draft of the National Coal Board Technical Handbook, "Spoil Heaps and Lagoons." D330

D73-2 ANALYSIS OF COAL REFUSE DAM FAILURE. MIDDLE FORK BUFFALO CREEK, SAUNDERS, WEST VIRGINIA

W. A. Wahler and Associates, Report to U.S. Bureau of Mines, Office of Deputy Director, Health and Safety, Volume 1. Chapters I-IX, Volume 2. Appendixes A, B, and C, Feb. 1973. NTIS, PB-215 142, PB-215 143. The first volume contains a summary and conclusions of the investigation, drawn from the body of the report; pertinent information on the Buffalo Mining Company's plant and its operation; a discussion of the geologic and engineering characteristics of the Buffalo Creek area; a description of coal refuse placement in Middle Fork Valley and its effects on the probable physical characteristics of the embankments and foundations; an analysis of the postfailure appearance of the site; a discussion of the probable mode of failure of the refuse dams; and a discussion of the consequences of the resulting flood. The second volume contains basic geologic and engineering data supporting the discussions and conclusions in Volume 1. These appendixes include data developed during the field and laboratory investigations, and other supporting information. (From Organization of the Report) D159, D160

D73-3 FLY ASH ACHIEVING DRAMATIC SUCCESS IN RECLAIMING COAL WASTE PILES

Babcock, A. (Monongahela Power Company), Coal Age 78 (4), 88-89 (1973). This article describes a number of locations where fly ash was used to condition coal waste piles which were then seeded. Results show the increase in the pH value of the reclaimed pile. Comparisons are made with the use of topsoil and fertilizers and mulch. Sewage sludge was also used in one instance. Results show that 1.5 in. - 2 in. of fly ash applied to a refuse pile will do a comparable job at considerably less cost than other methods. D29

D73-4 IDENTIFICATION AND MAPPING OF COAL REFUSE BANKS AND OTHER TARGETS IN THE ANTHRACITE REGION

Borden, F. Y., Thompson, D. N., and Lachowski, H. M. (The Pennsylvania State University), Symposium on Significant Results Obtained from Earth Resources Technical Satellite-1; Vol I - Technical Presentation, Section B, NASA Report SP-327 (1973). pp 1067-1074. This paper describes how ERTS-1 MSS data from Pennsylvania's Southern and Eastern Middle Anthracite Coal Fields were studied to see how well coal refuse accumulations could be identified and mapped by computer analysis and processing. A nine-mile-square section was used for the study. The photographic coverage was quite effective in detecting differences in reflectance of refuse, mine spoil, water, and reclaimed areas. The ERTS-1 data map has been found to be feasible and it also has produced additonal information on the topography of refuse areas. D361

D73-5 THE SCIENCE AND ECONOMICS OF COAL PREPARATION

Cammack, P., Colliery Guardian Annual Review, Sept. 1973. pp 84-89. This article on coal preparation in England includes a discussion of dewatering and disposal of the effluent solid refuse. D319

D73-6 STRIP MINE RECLAMATION IN ILLINOIS

Carter, R. P., Zimmerman, R. E., and Kennedy, A. S., Argonne National Laboratory, Energy and Environmental Studies Division, Report to Illinois Institute for Environmental Quality, Dec. 1973. 296 pp. A survey of lands affected by surface mining and by coal refuse piles before the passage of legislation requiring reclamation is the basis for this comprehensive study. Water quality data show that the Kaskasia, Big Muddy, and Saline are the major Illinois rivers in which significant mine-related pollution occurs. Water-treatment costs and reclamation costs are presented. There is also an analysis of tax revenue over a number of years from representative parcels of land. 73-38

D73-7 AMENDMENT TRIALS OF COAL SPOIL IN THE NORTH OF ENGLAND

Chadwick, M. J. (University of York, Great Britain), in "Ecology and Reclamation of Devastated Land," Vol. 2, R. J. Hutnik and G. Davis, Eds., New York: Gordon and Breach, 1973. Paper VI-4, pp 175-188. Various rates of limestone, several fertilizers, pulverized ash, and cationic bitumen emulsion were used with trees, grasses, and herbaceous legumes in six large-scale replicated trials on a variety of refuse types. Lime plus artificial fertilizer generally gave the best results. The several grasses and trees that were successfully grown on amended refuse are noted. 631 H981

D73-8 OPERATION ANTHRACITE REFUSE

Charmbury, H. B. and Chubb, W. R., The Pennsylvania State University, Coal Research Section, Special Research Report to U.S. Bureau of Mines and Pennsylvania Department of Environmental Resources, SR-94 (1973). 37 pp.+ The purpose of this work was to find new uses for anthracite refuse. Three new uses developed for incinerated refuse were: anti-skid material for

D73-8 (continued)

highways, substitute for aggregate in roadway blacktop, and as a soilless growing medium in greenhouses. Growth was obtained on incinerated refuse and silt basin refuse but was not too successful on raw refuse banks. A separate section on transportation shows how the distance the material must be hauled from its source affects the cost of using the refuse. 662.6 P4

D73-9 THE UTILIZATION OF INCINERATED ANTHRACITE MINE REFUSE AS AN AGGREGATE IN BITUMINOUS MIXES FOR SURFACING HIGHWAYS

Charmbury, H. B., Chubb, W. R., and Witkoski, F. C., The Pennsylvania State University, Special Research Report to Pennsylvania Department of Environmental Resources, SR-96 (1973). 27 pp. Conclusions from this study of the use of aggregate from burned-out refuse are that when properly crushed and sized it meets Department of Transportation specifications; that it has been used successfully in Luzerne County; and that skid resistance tests and visual inspections showed that the material held up as well in road tests as standard aggregate. 662.6 P4

D73-10 INVESTIGATION OF USE OF GEL MATERIAL FOR MINE SEALING

Chung, N. K., Dravo Corporation, Report to U.S. EPA, Office of Research and Monitoring, Environmental Protection Technology Series EPA-R2-73-135 (1973). 67 pp. Neutralized mine refuse was one filler used in an acrylamide grout for remote sealing of mine voids. The project, carried out in a mine near Keystone Park in western Pennsylvania, was to test a method of preventing acid mine drainage from an abandoned deep mine. 73-2

D73-11 COAL MINE HEALTH AND SAFETY INSPECTION MANUAL FOR COAL WASTE DEPOSITS

J. J. Davis Associates, Serendipity, Incorporated, and W. A. Wahler & Associates, prepared for U.S. Department of Interior, Mining Enforcement and Safety Administration, Contract No. S0133048, Sept. 1973. (114 pp.) The manual is intended to acquaint inspectors with the problems of coal waste disposal. It describes several refuse pile configurations and types of impoundments, and discusses the factors, especially water, that influence pile stability. Suggestions are given for making the inspection and recording observations. D331

D73-12 COAL MINE REFUSE AND FLY ASH TEAM UP AS BASE MATERIAL FOR HIGHWAY CONSTRUCTION

Coal Age 78 (13), 84 (1973). This news note describes the experimental parking lot and driveway installations at the U.S. EPA, Crown, West Virginia, Mine Drainage Field Site where coal refuse was used alone in an 18 inch base and as 75 percent of a mixture with fly ash in 12 and 15 inch bases. D283

D73-13 GOB PILE STABILIZATION, RECLAMATION, AND UTILIZATION

Coalgate, J. L., Akers, D. J., and Frum, R. W., West Virginia University, Coal Research Bureau, R&D Report No. 75, Interim Report No. 1 to U.S. Office of

D73-13 (continued)

Coal Research, Period of Performance Feb. 1972-May 1973. 127 pp. All phases of coal refuse handling and disposal are reviewed. Environmental hazards discussed include the prevention and control of refuse bank fires, refuse contribution to water pollution, and refuse bank instability. Methods of encouraging growth of vegetation on refuse, refuse pile construction, and refuse utilization are also discussed. D258

D73-14 RENKOL CLASSIFIER MAY BE MISSING LINK IN COAL PREPARATION

Collett, H., Coal Mining & Processing 10 (6), 30-33, 60 (1973). The Renkol classifier separates marketable coal from coal refuse piles. Slurry in the unit goes counterclockwise unlike conventional hydrocyclones. Adjustments can be made while the plant is running at operating rate. D110

D73-15 ESTABLISHING FOREST ON SURFACE-MINED LAND AS RELATED TO FERTILITY AND FERTILIZATION

Czapowskyj, M. M., U.S. Department of Agriculture, Northeastern Forest Experiment Station, Forest Service General Technical Report NE-3 (1973). Reprinted from Forest Fertilization Symposium Proceedings, pp 132-139. Although the emphasis is on fertility of strip-mined spoil, information is included on plant growth on coal refuse. R532

D73-16 PERFORMANCE OF RED PINE AND JAPANESE LARCH PLANTED ON ANTHRACITE COAL-BREAKER REFUSE

Czapowskyj, M. M. (U.S. Department of Agriculture, Northeastern Forest Experiment Station), in "Ecology and Reclamation of Devastated Land," Vol. 2, R. J. Hutnik and G. Davis, Eds., New York: Gordon and Breach, 1973. Paper VI-8, pp 237-245. All combinations of two levels of lime, two levels of fertilizer and four mulch treatments were used on a highly unfavorable site. The 4-year results show that lime application was essential for adequate survival and growth; pH values remained neutral in the top 4 inches of the limed plots; and neither mulch nor fertilizer treatments contributed substantially to tree establishment and growth. (From author's abstract) 631 H981

D73-17 LIME RETENTION IN ANTHRACITE COAL-BREAKER REFUSE

Czapowskyj, M. M. and Sowa, E. A., U.S. Department of Agriculture, Northeastern Forest Experiment Station, U.S. Forest Service Research Note NE-154 (1973). 4 pp. Hydrated lime was applied to extremely acid anthracite coal-breaker refuse at rates of 2.5 and 5.0 tons per acre. The lime raised the pH to neutral range, and this range was still in evidence 7 years after treatment. The pH readings decreased with the depth of the refuse profile, and below 9 inches they approximated those of the control plots. The 2.5-tons-of-lime-per-acre treatment was almost as effective as the 5.0-ton treatment. Application of lime in establishing vegetation on coal-breaker refuse is recommended and encouraged. (Authors' abstract) CE49

D73-18 RESEARCH ON RECLAMATION OF DEEP-MINE REFUSE PILES IN PENNSYLVANIA

Davidson, W. H., U.S. Department of Agriculture, Forest Service, Final Report to Pennsylvania Coal Research Board, 1973. 66 pp. Results of analyses of samples from more than 80 representative refuse piles in both anthracite and bituminous coal fields showed widely varying characteristics, but indicated that most refuse banks could support plant life, although most showed factors which could be adverse to plant establishment and development. Both greenhouse and field studies showed that soil amendments were needed to establish vegetation. Seedlings grown in six types of containers were compared with bare root seedlings. Containers did not improve survival on anthracite refuse, but two types of containers performed better on bituminous refuse. Recommendations for very acid spoil include addition of lime in advance of planting a seedling with follow-up applications if needed, and with refuse pH of 3.0 and below, covering it with soil suitable for plant establishment and growth. (From author's abstract) D165

D73-19 BUFFALO CREEK DAM DISASTER: WHY IT HAPPENED

Davies, W. E., Civil Engineering-ASCE 43 (7), 69-72 (1973). The coal waste banks and sludge ponds making up the Buffalo Creek dam site are described. The waste banks were used as dams because it had been found that water percolating through them was cleaned and complied with pollution control regulations. Investigation showed that the dam failed because there were no engineering plans or specifications for its construction. D317

D73-20 GEOLOGIC FACTORS IN WASTE BANK STABILITY

Davies, W. E. (U.S. Geological Survey), Mining Congress Journal 59 (1), 43-46 (1973). Refuse materials and topographical factors which add to waste bank instability are characterized. Some piles are high in bone coal, some in rock or clay and shale. Shale breaks down and is a very weak material when used as a foundation. Refuse should not be piled on washery sludge. Low bulk density material or light compaction gives weak stability. Void space in refuse piles is usually high and contributes to instability. Sandstone usually gives little trouble. This author believes special engineering is needed to get adequate stability in waste piles. D184

D73-21 DEMONSTRATION OF A TECHNIQUE FOR LIMITING THE SUBSIDENCE OF LAND OVER ABANDONED MINES

Candeub, Fleissig and Associates, Final Report to U.S. Department of Housing and Urban Development, Nov. 1973. 28 pp. This report describes a backfilling demonstration project conducted in the town of Rock Springs, Wyoming. Subsidence from mining had been substantial and damage which resulted is pictured. Dowell Division, Dow Chemical Company, used a new technique to hydraulically place 19,500 cubic yards of sand in an injection borehole. The Bureau of Mines then experimented in other areas using crushed mine refuse. The slurry is forced through a closed system into the mine void at high velocity and the solid spreads out over a wider area and fills more of the mine than in regular hydraulic backfilling. D358

D73-22 LIFE FORM SUCCESSION IN PLANT COMMUNITIES ON COLLIERY WASTE TIPS

Down, C. G. (The University, Bristol, Great Britain), Environmental Pollution 5 (1), 19-22 (1973). The study of refuse piles, 12, 15, 21, 55, and 98 years old, in the Somerset Coalfield, Great Britain, showed that the most plentiful naturally-occurring species were hemicryptophytes, with rosette hemicryptophytes comprising over thirty percent of the species on the youngest pile and less than twelve percent of the species on the oldest pile. CE606

D73-23 ENGINEERING CRITERIA FOR COAL WASTE DISPOSAL

D'Appolonia, E., American Mining Congress Coal Convention, Pittsburgh, Pennsylvania, May 6-9, 1973. 10 pp. Also in Mining Congress Journal 59 (10), 42-46 (1973). Concern for safety and environment requires criteria for the design and operation of areas for coal refuse. The main technical criteria relate to stability of embankment, ground water movement, and routing of storm floods. Critical also in application of these criteria are capital investment, maintenance and abandonment costs. Environmental consideration of leachates which are highly acidic, alkaline, toxic and exhibit other degrading characteristics relate directly to technical criteria for ground water flow and safety of coal refuse embankments. (Author's abstract) 662.6 A665

D73-24 FEASIBILITY STUDY, LAKE HOPE MINE DRAINAGE DEMONSTRATION PROJECT

Ohio Department of Natural Resources, Report to U.S. EPA, Office of Research and Monitoring, Environmental Protection Technology Series EPA-R2-73-151 (March 1973). 97 pp. Removal or burial of coal refuse both from active and inactive mines in the demonstration project improved the asthetics of the area and the water quality of Lake Hope. D31

D73-25 SUMMARY OF DEMONSTRATION METHODS FOR EXTINGUISHING CULM-BANK FIRES

Flegal, R. C. and Gahr, N. J., U.S. EPA, Research Triangle Park, North Carolina, Inhouse Report No. APTD-1518, July 1973. 46 pp. NTIS, PB-222 836. Sealing, grouting, and mechanical-hydraulic methods of extinguishing burning coal-refuse banks were evaluated through 15 demonstration grants in three Appalachian states. Mechanical-hydraulic methods were most successful in terms of effectiveness and economy. However, these methods require large quantities of water and a large disposal area, neither of which may be available at the burning waste-bank site. The wide diversity of coal-refuse-bank sizes, shapes, compositions and locations makes selection of a universally recommended control method impossible. (From authors' abstract) D335

D73-26 ABNORMALITIES IN THE ROOTS OF TREES GROWING ON TOXIC DUMP MATERIAL

Harabin, Z. and Greszta, J. (Polish Academy of Science), in "Ecology and Reclamation of Devastated Land," Vol. 1, R. J. Hutnik and G. Davis, Eds., New York: Gordon and Breach, 1973. Paper IV-2, pp 413-428. A coal waste dump was one of the industrial dumps investigated. In toxic soils all tree species

D73-26 (continued)

formed flat root systems with virtually all root development in the near surface layers. Anatomical changes seen could have been caused by this or directly by the toxicity of the dumps. 631 H981

D73-27 SYNTHESIS OF LIGHTWEIGHT AGGREGATES FROM LOW CALORIC WASTE COAL DUST

Iryo, M. (to Asia Technical Consultant Co.), Japanese Kokai 73-79821 (Oct. 26, 1973). 4 pp. Coal refuse, coarse sand, and activated sludge are mixed in specified proportions, pelletized, dried, and sintered to form lightweight aggregate. J Pat

D73-28 UNUSUAL DEPOSIT YIELDS QUALITY LIGHTWEIGHT AGGREGATE

Jeffers, P. E., Brick & Clay Record, Feb. 1973. pp 20-22. Coal is reclaimed from anthracite refuse and the residue crushed and expanded to make "Lelite." The Bylite Corporation of Wilkes-Barre produces up to 450 tons per day of the aggregate which has been used in the construction of large buildings in eastern cities. D321

D73-29 INVESTIGATIONS OF SOILS AND TREE GROWTH ON FIVE DEEP-MINE REFUSE PILES IN THE HARD-COAL REGION OF THE RUHR

Knabe, W. (Northrhine-Westphalian Institute for Air Pollution Control and Land Use Protection), in "Ecology and Reclamation of Devastated Land," Vol. 1, R. J. Hutnik and G. Davis, Eds., New York: Gordon and Breach, 1973. Paper III-4, pp 307-324. The investigations showed that both burned and unburned refuse piles in the Ruhr can be successfully forested. Existing stands of hardwood have been able to reproduce themselves and promote soil development. Species recommended for planting are noted. 631 H981

D73-30 CONTROL OF MINE DRAINAGE FROM COAL MINE MINERAL WASTES: PHASE II - POLLUTION ABATEMENT AND MONITORING

Kosowski, Z. V., Consolidation Coal Company, Report to U.S. EPA, Office of Research and Monitoring, Environmental Protection Technology Series EPA-R2-73-230 (May 1973). 83 pp. This final report gives the results of an extensive project on mine drainage control and reclamation done at the New Kathleen Mine Site, and the coal cleaning operation of the Union Collieries Company. The site had a 40-acre refuse pile and six slurry lagoons. Soil covers of 1 foot, 2 feet, and 3 feet thicknesses were tested. The results showed that a 1-foot cover controlled acid production as well as a 3-foot cover. A number of vegetative covers were tested using standard agricultural techniques. Maintenance on the pile the first year showed that it is important to reseed and recover bare spots, otherwise the acid production will increase. Extensive detail is included on measuring acid flow rates. Conclusions on fertilizers, seed mixtures, and lime requirements indicated that because of wide variations in soil conditions, no specific guidelines can be recommended. Acid control was effective - before treatment the rate was 198 lbs/acre/day and after treatment it was 6 lbs/acre/day. D123

D73-31 PENNSYLVANIA REGULATIONS FOR COAL REFUSE DISPOSAL

Lazarchik, D. A. (Pennsylvania Bureau of Land Protection), American Mining Congress Coal Convention, Pittsburgh, Pennsylvania, May 6-9, 1973. 14 pp. The author discusses background of refuse handling and disposal procedure and reviews the development of rules and regulations, issued as a proposed document in August, 1972. Following a November hearing in 1972 a draft of the regulations was published on December 23, 1972. The steps required for a permit are outlined together with the respective fees. Application details are discussed and site maintenance procedures are explained. Generally, the state's attempt to regulate coal refuse piles is concerned with air pollution, water pollution, safety and appearance. 662.6 A665

D73-32 WASTE COAL RECLAMATION

Leonard, J. W. and Lawrence, W. F., West Virginia University, Coal Research Bureau, Report No. 92 (undated). 8 pp. Also in ACS Division of Fuel Chemistry Preprints 18 (2), 232-238 (1973). The authors summarize the coal waste problem by discussing conditions in eleven representative years from 1917 through 1972. The size and composition of some coal waste banks in the Monongahela River drainage basin are tabulated. D316

D73-33 THE EFFECT OF SUSPENDED COAL PARTICLES ON THE LIFE FORMS OF THE AQUATIC MOSS EURHYNCHIUM RIPARIOIDES (HEDW.) I. THE GAMETOPHYTE PLANT; II. THE EFFECT ON SPORE GERMINATION AND REGENERATION OF APICAL TIPS

Lewis, K. (University College, Cardiff, Wales), Freshwater Biology 3, 251-257, 391-395 (1973). The aquatic moss which is the subject of this study is commonly found throughout Great Britain, even, a survey showed, in discharges of coal washery water. Part I describes the laboratory study of the effects on the moss of suspensions of 100, 500, 1000, 2000, and 5000 mg/L of coal related solids. The suspended solid particles caused abrasion of the plants. Above 500 mg/L concentration, the suspended solids reduced growth significantly, probably as the result of abrasion, but also possibly because of reduced availability of light. Part II describes a second laboratory study, using the same concentrations of suspended coal solids, which was carried out with spores from mature capsules of the moss. Germination of the spores did occur with all suspensions, but was greatly decreased with the greatest concentration of solids. Part II also reports a laboratory study on apical tips of the plant material, freshly prepared without side shoots. After twenty days, lateral shoots had grown on plant material in controls and in low concentrations of solids, but none were produced in suspensions of 1000 mg/L or more. CE158

D73-34 CONSTRUCTING NON-POLLUTING COAL MINE WASTE DISPOSAL SYSTEMS

Lounsbury, R. E., Mining Engineering 25 (6), 48-51 (1973). The design and planning for the refuse disposal system operated by Monterey Coal Company at

D73-34 (continued)

its No. 1 Mine in Brushy Mound Township, Illinois, are described. The system includes provision for constructing and maintaining slurry ponds and refuse embankments. The operating experience for more than two years is reviewed. Jour

D73-35 HAWLEY SUCCESSFUL IN ADAPTING SYSTEM TO RECOVER ULTRA-FINES

Mason, R. H., Coal Mining & Processing 10 (5), 35-39, 55 (1973). A processing plant was developed in West Virginia to reclaim the fine coal from settling ponds when they became filled and additional space was not available. The method was adapted from one used by equipment to process chemicals and prepare foods and is effective with maximum moisture content of 22 percent. The system uses heated air during conveying and a special chopper to break up caked material. The fluid drying and conveying system will handle 21 tph and reduce the moisture content by 10 points. Ash content is also reduced from 20 percent to 12 percent. The dryer exhaust emissions have been maintained below the state code requirements. D114

D73-36 METHODS AND COSTS OF COAL REFUSE DISPOSAL AND RECLAMATION

U.S. Bureau of Mines, IC 8576 (1973). 36 pp. NTIS, N75-77143/6WP. Coal refuse disposal and reclamation methods and costs are presented for one coal company in Kansas, three in Kentucky, one in Ohio, two in Pennsylvania, and two in West Virginia. Six reclamation projects sponsored by the Commonwealth of Pennsylvania are also included. (From introduction) D77

D73-37 NEW USES FOR FLY ASH AND MINE WASTE: FLY ASH, COAL WASTE MADE INTO AGGREGATE; EPA UTILIZES MINE REFUSE-FLY ASH BASE COURSE IN ROAD CONSTRUCTION TEST AT CROWN CENTER

Green Lands 3 (3), 20 (1973). The first of these two news items reports on a new patented aggregate called "LAPIDEX," developed in Hungary. The second summarizes EPA's use of the two waste products in paving projects at their Crown, West Virginia, facility. D251

D73-38 ENVIRONMENTAL, LAYOUT AND PROCESS INNOVATIONS IN THE BULLITT PLANT

O'Brien, E. J. and Walker, J. L., Jr. (Dravo Corporation), Mining Congress Journal 59 (5), 36-42 (1973). The refuse handling system of the coal preparation plant at the Bullitt mine of Westmoreland Coal Company is designed to return impounded water to the plant and to produce a solid cake dry enough to handle mechanically. There is one slurry pond to be used only in emergency. D109

D73-39 EMERGENCY INVESTIGATION OF COAL WASTE EMBANKMENTS

Osborn, E. E. (U.S. Bureau of Mines), Mining Congress Journal 59 (1), 40-42 (1973). A special Task Force of the Department of the Interior has worked to

D73-39 (continued)

make an inventory of coal refuse banks and impoundments and conducted emergency investigations of a number of the sites. The program and its findings are reviewed. D183

D73-40 DEEP-MINE WASTE RECLAMATION EXPERIMENTATION IN THE BITUMINOUS REGIONS OF PENNSYLVANIA

Schimp, P. E. (Bethlehem Mines Corporation), in "Ecology and Reclamation of Devastated Lands," Vol. 2, R. J. Hutnik and G. Davis, Eds., New York: Gordon and Breach, 1973. Paper VII-8, pp 457-467. Factors studied were germinative ability of seeds of trees, perennial grasses, and annuals; effects of planting procedures and fertilizing methods on survival and growth of tree and shrub seedlings; and effects of refuse bank conditions on vegetation. High soil temperature from absorption of solar radiation and low soil moisture were found to have the greatest effect on plant survival. 631 H981

D73-41 SEALING OF COAL REFUSE PILES

Scott, R. B., U.S. EPA, National Environmental Research Center, Advanced Waste Treatment Laboratory, Crown, West Virginia, Program Element 1B2040, July 1973. 15 pp. Seven 14' x 14' x 12" deep containers were constructed for the coal refuse so that water percolating through the pile could be measured. There was a control pile and six test piles: one with plastic covering; two treated for carbonate bonding; one covered with clay-type soil; one treated with sodium silicate; and one with sodium silicate and sodium aluminate. Water going through each pile was measured after major storms or after a period with at least 2" precipitation and tested for conductance, pH, acidity, alkalinity, calcium, magnesium, aluminum, sulfate, and total iron. The results show that the plastic cover was the most successful sealant although it required constant attention to keep it in place. Sodium silicate treatment was the second most successful treatment but seemed to be losing its effectiveness at the end of the almost year-long test period. Carbonate bonded layers at first were successful but broke up under weathering. It was suggested that lack of moisture during treatment and too little compaction because of hand tamping contributed to failure. 73-17

D73-42 BULK TRANSPORT OF ANTHRACITE REFUSE

Semon, E. A. and Schenck, G. H. K., The Pennsylvania State University, Special Research Report to Pennsylvania Department of Environmental Resources, SR-93 (Jan. 30, 1973). 194 pp. Railroad, truck and pipeline rates, availability, convenience, and dependability are compared. One section of the report considers the recovery of anthracite fines from culm banks for use as power plant fuel. 662.6 P4

D73-43 PRINCIPLES OF DAM CONSTRUCTION

Starnes, W. L., Mining Congress Journal 59 (1), 47-50 (1973). Key factors in dam construction include suitable soils, competent design engineering, impervious core, proper compaction, inert material, and regular inspections.

D73-43 (continued)

Reference is made to coal refuse dams and a number of reasons for their failure. An earthen core is considered a necessary part of a refuse dam. Dams whose slopes are equal to the angle of repose of the refuse are too high and are undoubtedly unsafe. Proper compaction of refuse material is essential. D185

D73-44 COAL REFUSE DISPOSAL IN PENNSYLVANIA

Steinman, H. E. (Jones & Laughlin Steel Corporation), American Mining Congress Coal Convention, Pittsburgh, Pennsylvania, May 6-9, 1973. 14 pp. Methods of coal refuse disposal and variables in refuse origin and characteristics are reviewed and related to Pennsylvania's Coal Refuse Disposal Act of 1968 and to other proposed regulations. The author recommends using refuse such as in embankment and highway construction projects and in producing building materials to overcome the disadvantages of refuse disposal piles. 662.6 A665, CE116

D73-45 COAL MINING REFUSE DISPOSAL - TODAY AND TOMORROW

Taylor, A. R., Colliery Guardian Annual Review, Sept. 1973. pp 91-96. British experience in dealing with coal refuse and the National Coal Board rules and regulations covering refuse disposal are reviewed. D320

D73-46 COMPOSITIONAL AND GEOTECHNICAL CHARACTERISTICS OF A 100-YEAR-OLD COLLIERY SPOIL HEAP

Taylor, R. K. (University of Durham), Institution of Mining and Metallurgy, Transactions, Section A 82, A1-A14; Discussion of the paper, A145-A147 (1973). Samples were taken at a number of locations throughout the partially burnt, very coaly heap. Also determined as far as possible were the coal measures from which the refuse had come. Chemical-mineralogical correlation indicated that combustion in the heap had greatly changed its mineral constituents. D325

D73-47 COLLIERY SPOIL TIPS--AFTER ABERFAN

Thomson, G. M. (1) and Rodin, S. (2) [(1) National Coal Board, U.K. and (2) Wimpey Laboratories Ltd.], The Institution of Civil Engineers, London, ICE Paper 7522 (1972). 60 pp. Discussion of the paper, Proceedings Institution of Civil Engineers 55, 677-712 (Sept. 1973). The problems of refuse pile stability are reviewed and the development and design of methods recommended to alleviate these problems are discussed in detail. The refuse disposal area at Aberfan, a number of other disposal areas in Great Britain, and, in the Discussion, the area at Buffalo Creek, West Virginia, are used to illustrate various factors such as moisture content and physical properties of refuse, hydrology and drainage of refuse piles, compaction of the disposal area, and effects of subsidence on refuse piles. CE603

D73-48 MANUFACTURE OF LIGHTWEIGHT AGGREGATES FROM WASHERY SCREEN DISCARD

Toubeau, G., Sixth International Coal Preparation Congress Symposium, Paris, France, 1973. (12 pp.) The production of lightweight aggregate from coal cleaning refuse in Belgium is described. The plant, situated at Roselies on the Sambre River uses refuse from the Aiseau-Presle Colliery as one source of raw material. CE53

D73-49 MCGREGOR PLANT GETS NEW COMBINATION CIRCUIT

Walls, D., Coal Mining & Processing 10 (7), 50-53 (1973). The 400-tph combination hydrocyclone-heavy media coal-cleaning circuit developed by Amherst Coal Company is described. Flow sheets and analyses of separation fractions are included. R86

D73-50 THE DISPOSAL OF COAL WASHERY REJECTS IN AUSTRALIA

Waters, P. L. (CSIRO Division of Mineral Chemistry), PACE 26 (9), 17-19 (1973). In test studies, fluidized-bed combustion of coal-cleaning refuse gives a light-colored, inert, granular product suitable as a road fill, building material, or soil conditioner. The resulting fly ash has useful pozzolanic properties for cement and concrete products. D355

D73-51 FLOCCULATION OF COAL SLIMES

Werneke, M. F. (to American Cyanamid Company), U.S. Patent 3,717,574 (Feb. 20, 1973). 3 pp. Colloidal coal particles in aqueous alkaline medium are flocculated by the combined action of a low molecular weight water-soluble anionic polymer at least 50 mol percent composed of acrylic acid linkages and a high molecular weight anionic polymer at least 95 mol percent composed of acrylamide linkages, and adjusting the pH of the aqueous medium to a value below 7. A water-soluble anionic starch may be added as supplementary flocculant. (Abstract of the disclosure) D334

1974

D74-1 GOB PILE STABILIZATION AND RECLAMATION

Akers, D. J., Jr. and Muter, R. B., Proceedings of the Fourth Mineral Waste Utilization Symposium, Chicago, Illinois, by U.S. Bureau of Mines and IIT Research Institute, 1974. pp 229-239. Also published with J. L. Coalgate as West Virginia University, Coal Research Bureau, Technical Report No. 96 (1974). 21 pp. Gob pile fires and their control and prevention; water pollution and physical instability, including surface and subsurface slips, creep, liquefaction, and erosion; and revegetation and site preparation are discussed in this comprehensive paper. 622 M6, D372

D74-2 ANALYSIS OF POLLUTION CONTROL COSTS

Michael Baker, Jr., Inc., Report to Appalachian Regional Commission, Feb. 1973. 436 pp. Also published as Doyle, F. J., Bhatt, G., and Rapp, J. R., Michael Baker, Jr., Inc., Report to Appalachian Regional Commission and U.S.

D74-2 (continued)

EPA, Office of Research and Development, Environmental Protection Technology Series EPA-670/2-74-009 (Feb. 1974). 437 pp. NTIS, PB-233 026/4WP. The purpose of this publication is to provide data which will enable the Commission to estimate costs of pollution abatement in the Monongahela River Basin. Pollution both from coal mining and from non-coal sources is considered. Abatement methods discussed include mine sealing, stream diversion, and mine drainage treatment. 73-8, 74-11

D74-3 THE TECHNICAL AND ECONOMIC FEASIBILITY OF UNDERGROUND DISPOSAL SYSTEM

Atwood, G. (Geologist), National Coal Association/Bituminous Coal Research, Inc., First Symposium on Mine and Preparation Plant Refuse Disposal Preprints, Louisville, Kentucky, 1974. pp 147-160. European practices in pneumatic and hydraulic stowing of refuse in mined-out areas are reviewed. The costs of the methods are compared to the costs of surface disposal. Under conditions current when the paper was prepared, underground disposal was more expensive than surface disposal. D456

D74-4 CHARACTERIZATION OF COAL REFUSE BY LOW TEMPERATURE ASHING

Augenstein, D. A. and Sun, S. C., Transactions of AIME 256, 161-166 (1974). The apparatus and procedure are described. The mineral matter and the chemical constituents of the ash of 7 anthracite coals are tabulated. AIME

D74-5 ECOLOGY OF IRON-OXIDIZING BACTERIA IN PYRITIC MATERIALS ASSOCIATED WITH COAL

Belly, R. T. and Brock, T. D. (University of Wisconsin, Department of Bacteriology), J. Bacteriology 117 (2), 726-732 (1974). This work describes a method for measuring $^{14}CO_2$ uptake by chemolithotrophic bacteria directly in pyritic materials associated with coal and coal refuse. Maximal $^{14}CO_2$ uptake occurred in coal refuse material 2-3 years old, and only slight incorporation was demonstrated in fresh material or material 40 years old. Surface samples demonstrated maximal $^{14}CO_2$ uptake as compared to samples below 8-10 cm with only slight activity. Optimum uptake activity occurred at 20-30°C, and a moisture content of 23-35%. Heterotrophic fungi and yeasts were routinely isolated in high numbers from acidic coal refuse. There was good correlation between $^{14}CO_2$ uptake and the most probable number of iron-oxidizing bacteria. (From authors' abstract) 74-4

D74-6 A REFUSE BANK RECLAMATION PROJECT

Blakely, J. W., Coal Mining & Processing 11 (2), 30-31 (1974). A 30-acre refuse bank at the Winifrede Division of Carbon Fuel Company, Kanawha County, West Virginia, has been graded, covered with clay and topsoil, seeded, and planted with 300 apple trees. Current refuse continues to be deposited in the area in such a way that reclamation can continue. Natural drainage has been

D74-6 (continued)

channeled away from the refuse bank. Preparation plant water goes to a settling basin at the toe of the refuse pile and empties into an abandoned mine from which, in turn, the water is obtained for the preparation plant. D315

D74-7 CLASSIFICATION AND MAPPING OF COAL REFUSE, VEGETATIVE COVER TYPES, AND FOREST TYPES BY DIGITAL PROCESSING ERTS-1 DATA

Borden, F. Y., Merembeck, B. F., Thompson, D. N., Turner, B. J., and Williams, D. L., The Pennsylvania State University, Office for Remote Sensing of Earth Resources, Space Science and Engineering Laboratory, Journal paper No. 4680, April 23, 1974. pp 133-152. The data processing used with the system is described. One of the applications of the system shown is monitoring coal refuse disposal areas in the anthracite region of eastern Pennsylvania. CE966

D74-8 DEPTH OF SOIL COVERING REFUSE (GOB) VS. QUALITY OF VEGETATION

Brundage, R. S. (Peabody Coal Company), National Coal Association/Bituminous Coal Research, Inc., First Symposium on Mine and Preparation Plant Refuse Disposal Preprints, Louisville, Kentucky, 1974. pp 183-185. Evaluation of vegetation that had been growing on soil-covered refuse areas for up to eleven years showed no difference in growth on coverings of 1, 2, 3, or 4 feet. Areas with less than 8 inches of soil cover had obviously less vegetative cover. Recommendations for covering abandoned piles include proper grading; covering with 12 to 18 inches of soil capable of supporting vegetation; and planning vegetation to reduce erosion and to prepare the site for future use. D460

D74-9 PHYSICAL PROPERTY DATA ON COAL WASTE EMBANKMENT MATERIALS

Busch, R. A., Backer, R. R., and Atkins, L. A., U.S. Bureau of Mines, RI 7964 (1974). 142 pp. Eight coal waste banks in West Virginia were chosen for study. In situ density tests were carried out. Sampling was carried out for laboratory characterization of material including permeability, grain size gradation, specific gravity, shear strength, and compression. Among the recommendations are that local information on specific gravity and density should be obtained, since these values for the samples studied varied considerably; and that work should be done, in the field, on pile density control to improve stability. D368

D74-10 UTILIZATION OF COAL MINE REFUSE IN THE CONSTRUCTION OF HIGHWAY EMBANKMENTS

Butler, P. E. (Pennsylvania Department of Transportation), National Coal Association/Bituminous Coal Research, Inc., First Symposium on Mine and Preparation Plant Refuse Disposal Preprints, Louisville, Kentucky, 1974. pp 237-255. Studies on grain-size distribution and moisture density relationship showed that refuse could be compacted to keep air out and prevent combustion. This was confirmed by monitoring with thermocouples an embankment

D74-10 (continued)

built from refuse on the Cross Valley Expressway in Luzerne County, Pennsylvania. Other projects planned for use of refuse are listed. D465

D74-11 FLY ASH FROM COAL BURNING POWERPLANTS: AN AID IN REVEGETATING COAL MINE REFUSE AND SPOIL BANKS

Capp, J. P. and Gillmore, D. W. (U.S. Bureau of Mines, Morgantown, West Virginia), National Coal Association/Bituminous Coal Research, Inc., First Symposium on Mine and Preparation Plant Refuse Disposal Preprints, Louisville, Kentucky, 1974. pp 200-211. Although the emphasis in this paper is on fly ash amendments to surface mine spoil and agricultural land, almost 60 acres of refuse disposal areas are noted as having benefited by fly ash addition. D462

D74-12 SOIL-MAKING POTENTIAL OF POWERPLANT FLY ASH IN MINED-LAND RECLAMATION

Capp, J. P. and Gillmore, D. W. (U.S. Bureau of Mines, MERC), in "Ash Utilization," Proceedings of the Third International Symposium, Pittsburgh, Pennsylvania, 1973, U.S. Bureau of Mines IC 8640 (1974). pp 258-268. The use of fly ash in restoring surface mine spoils and coal waste dumps is related to its alkaline character and ability to neutralize acid materials, the addition of mineral nutrients, its positive effect on moisture holding capacity, and decrease in soil and refuse material bulk density. Plants growing well on fly ash-treated materials are listed. Costs of using fly ash are also estimated. BurM

D74-13 COAL AND THE ENVIRONMENT

Charmbury, H. B., Coal Mining & Processing 11 (1), 69-70 (1974). The author points out ways to handle refuse and water during the mining operation and gives guidelines for building refuse piles. Jour

D74-14 CLEANING UP COAL WASTES

Ecos, CSIRO Environmental Research No. 1, Aug. 1974. pp 11-14. The problems of coal refuse disposal and the studies carried out in Australia to use refuse as a low-grade fuel in fluidized-bed combustion are reviewed. CE48

D74-15 COAL REFUSE PILES SEEN AS VALUABLE GAS SUPPLY

Earthmoving and Construction, p 24, Summer 1974. Dr. Philip Walker of The Pennsylvania State University explains in this news note that coal refuse can be used in commercial gasifiers to produce low Btu gas for process heat. Present research at Penn State concerns determination of coals suitable for different gasifiers. D356

D74-16 COLLIERY SPOIL

Precast Concrete 5 (7), 393-396 (1974). The uses of coal refuse (colliery spoils) in Britain are described. Chemical analyses of burnt and unburnt

D74-16 (continued)

spoils are tabulated. Also tabulated are quantities of spoil in NCB ownership in 1966, by area. D380

D74-17 A NEW CONCEPT IN STABILITY ANALYSIS OF SEEPED MINE-REFUSE EMBANKMENTS

Corp, E. L. and Schuster, R. L. (U.S. Bureau of Mines, Spokane Mining Research Center), National Coal Association/Bituminous Coal Research, Inc., First Symposium on Mine and Preparation Plant Refuse Disposal Preprints, Louisville, Kentucky, 1974. pp 91-114. A new analysis concept using finite-element methods has been developed to combine the effects of seepage directly into computations for slope stability of dams or embankments. Seepage forces, superimposed on gravity loads, are used in an elastic-plastic program to compute slope factors of safety. Computer output provides a cross-sectional plot of the dam or embankment showing the safety factors for each element. The method was first tested using trial embankments, and the results compared with those obtained from conventional analysis. Both methods predict failure, but the finite-element analysis shows a different mode of failure and development of potential failure zones not indicated by conventional methods. To test the validity of the concept, both new and conventional analyses were compared for the 1972 Buffalo Creek dam failure. Findings of the finite-element model corroborate those of conventional methods, and in addition show an alternative mode of failure. (From authors' abstract) D452

D74-18 PNEUMATIC STOWING: IT MUST BE LOOKED AT NOW

Courtney, W. J. and Singh, M. M., Coal Mining & Processing 11 (2), 27-29, 43-44 (1974). Machinery used in pneumatic stowing is described and costs at several European mines are compared. The lateral method of stowing has been developed to keep up with the rapidly advancing longwall face. D314

D74-19 THE ONEIDA PLANT

Daub, C. H., Mining Congress Journal 60 (7), 20-27 (1974). The new coal preparation facility at the Conemaugh No. 4 Mine of the North American Coal Corporation subsidiary, Oneida Mining Company, is described. Refuse disposal is in an area designed to carry runoff into the mine where it will be added to the mine water to be treated. Two slurry disposal ponds are also planned. Clear water will be returned from the ponds to the preparation plant. D352

D74-20 RECLAIMING REFUSE BANKS FROM UNDERGROUND BITUMINOUS MINES IN PENNSYLVANIA

Davidson, W. H. (U.S. Department of Agriculture, Northeastern Forest Experiment Station), National Coal Association/Bituminous Coal Research, Inc., First Symposium on Mine and Preparation Plant Refuse Disposal Preprints, Louisville, Kentucky, 1974. pp 186-199. Chemical and physical analyses of samples from 79 sites showed a wide variation in results but indicated generally that although chemical parameters were unfavorable to plant growth, physical characteristics were not. Greenhouse and field studies showed that lime and fertilizer were needed to establish grasses on refuse banks. Field

D74-20 (continued)

studies showed further that a mulch was also needed. Tree (red pine) survival did not seem to be influenced by soil amendments. The results of a field study on the effects of furrowing were inconclusive. D461

D74-21 CURRENT STATUS OF PROPOSED FEDERAL WASTE DISPOSAL RULES

Day, J. M., American Mining Congress Coal Convention, Pittsburgh, Pennsylvania, May 5-8, 1974. 9 pp. Also published in Mining Congress Journal 60 (6), 53-56 (1974). The activities of the Mining Enforcement and Safety Administration included the development of Hazard and Emergency Hazard Rating Systems and The Coal Mine Health and Safety Inspection Manual for Coal Mine Waste Deposits, and work on evaluating stability of coal waste deposits. D346

D74-22 THE RELATIONSHIP BETWEEN COLLIERY-WASTE PARTICLE SIZES AND PLANT GROWTH

Down, C. G. (The University, Bristol, Great Britain), Environmental Conservation 1 (4), 281-284 (Winter 1974). Material from twelve-year-old coal refuse from the Somerset coalfield, Great Britain, was separated into seven fractions according to particle size. Perennial rye grass was sown on three replicate plots of each size material. Germination was much better in the smaller size fractions than in the larger. Also, there was better growth in the smaller size fractions. After thirty days of growth, the plants on the largest materials were not living, and similar amounts of growth had taken place on the five smaller size fractions. CE649

D74-23 VARIABLES AFFECTING GRADING COSTS FOR STRIP MINE AND REFUSE BANK RECLAMATION

Doyle, F. J. (Michael Baker, Jr., Inc.), National Coal Association/Bituminous Coal Research, Inc., First Symposium on Mine and Preparation Plant Refuse Disposal Preprints, Louisville, Kentucky, 1974. pp 212-227. Of the many site characteristics identified and tabulated, the volume of refuse to be moved is considered as being the main cause of differences in grading costs from one project to another. D463

D74-24 SYNOPSIS OF ENGINEERING AND DESIGN MANUAL FOR COAL REFUSE EMBANKMENTS

Ellison, R. D. and Almes, R. G. (E. D'Appolonia Consulting Engineers, Inc.), National Coal Association/Bituminous Coal Research, Inc., First Symposium on Mine and Preparation Plant Refuse Disposal Preprints, Louisville, Kentucky, 1974. pp 115-127. The purposes of this paper are to describe briefly the content of the Manual prepared for the Mining Enforcement and Safety Administration, and to illustrate its utility to regulatory agencies, coal operators, and consultants retained to assist in the design and implementation of safe coal refuse disposal practices. D453

D74-25 EUROPEAN PRACTICE IN UNDERGROUND STOWING OF WASTE FROM ACTIVE COAL MINES

Fairhurst, C. (University of Minnesota), National Coal Association/Bituminous Coal Research, Inc., First Symposium on Mine and Preparation Plant Refuse Disposal Preprints, Louisville, Kentucky, 1974. pp 145-146. This abstract of the Symposium presentation emphasizes the fact that disposal of refuse in underground mines in Europe was developed in response to a need for refuse disposal and to aid in solving problems of mining including surface subsidence, ground disturbance with multiple-seam mining, and "bumps" or violent collapse of mine workings because of pressure buildup. D455

D74-26 OVERVIEW OF UNDERGROUND REFUSE DISPOSAL

Falkie, T. V., Gilley, J. E., and Allen, A. S. (U.S. Bureau of Mines), National Coal Association/Bituminous Coal Research, Inc., First Symposium on Mine and Preparation Plant Refuse Disposal Preprints, Louisville, Kentucky, 1974. pp 128-144. The paper reviews the status of coal refuse and various methods of using or disposing of the waste material. The authors conclude that, "Stable surface disposal systems can be designed with pre-planning, site selection, and reclamation to return the surface area to use following mining. Utilization of refuse will occur on a local basis only, without much potential for large scale use other than as land- or construction-fill or as backfill material in subsidence control projects. Underground disposal of coal waste in abandoned mines is feasible and has been used. Two goals are achieved - subsidence control and surface improvement. Disposal in active mines appears feasible in certain instances, however, problems in mining economics, mine worker safety, and environmental problems remain to be solved before the practice can be adopted as a part of the production cycle." D454

D74-27 ROOT PENETRATION OF LOLIUM PERENNE ON COLLIERY SHALE IN RESPONSE TO RECLAMATION TREATMENTS

Fitter, A. H. and Bradshaw, A. D. (University of Liverpool, U.K.), J. Applied Ecology 11 (2), 609-615 (1974). Field and greenhouse experiments were carried out with surface applications of limestone and fertilizer at various levels. One group of field plots was treated with phosphate. Only the greenhouse pots were watered. Results showed that in field experiments fertilizer rate was more important for promoting root growth than limestone. The effect of pH in controlling rooting depth was apparent mainly in the greenhouse trials where the critical value was 4.1. Merely providing phosphorus did not stimulate root penetration to the same degree as the use of commercial fertilizer. The authors suggest that root growth may be stimulated directly by the presence of nutrients at a particular depth and recommend deep incorporation of fertilizers. CE588

D74-28 THE USE OF UNBURNT COLLIERY SHALE IN ROAD CONSTRUCTION

Fraser, C. K., Great Britain, Department of the Environment, Transport and Road Research Laboratory, Scottish Branch, Supplementary Report 20 UC (1974). 7 pp.+ Observations and data from engineers who have used unburnt colliery shale for several years for road embankments and fill are contained in this

D74-28 (continued)

report. There seem to have been no instances of combustion even in areas where the recommended inert cladding had been omitted. It is noted that no special restrictions beyond general engineering requirements were needed for shale use; and that ease of handling shale in wet weather is the most significant advantage of its use. CE230

D74-29 PLANTING TREES ON WASTE LAND

Gemmell, R. P., Surveyor 144 (4288), 30-32 (1974). The author describes the planting techniques needed for raw wastes including colliery spoil. Limestone must be applied by deep cultivation in order to raise the pH significantly. This promotes deep rooting which improves survival. A fertilizing project is described showing the clear need for nitrogen and phosphate in addition to limestone. Dried sewage sludge proved to be a good soil amendment. Preplanting of grasses can improve tree growth and survival. D375

D74-30 STATE OF THE ART OF SUBSIDENCE CONTROL

Gray, R. E., Gamble, J. C., McLaren, R. J., and Rogers, D. J., General Analytics, Inc., Final Report to Appalachian Regional Commission and Pennsylvania Department of Environmental Resources, ARC--73-111-2550 (1974). 273 pp. NTIS, PB-242 465/AS. For abandoned mines, selective support methods, such as grout columns, deep foundations and piers; and filling methods, such as hydraulic flushing, pneumatic filling, fly ash injection, grouting, blasting and over-excavation are described and approximate costs presented. Techniques to evaluate subsidence potential are included. For active mines, principles of subsidence development above tabular deposits are discussed, including a review of research studies and predictive methods. Subsidence control, by cancelling or selectively positioning surface strains, and subsidence prevention by subsurface support are described with examples. There are 192 annotated references. (From authors' abstract) D420

D74-31 FILTRATION OF COAL REFUSE

Hegyan, D. T. and Zugates, T. B., AIME Annual Meeting, Dallas, Texas, Feb. 23-28, 1974. Preprint No. 74-F-23. 19 pp. Also in Transactions of AIME 260, 77-80 (1976). This paper discusses the authors' experience filtering refuse, the effects of solids concentration in the filter feed, the use of polymer flocculation aids, the effect of flocculation devices, and the effects of particle size and ash content on the filtration rate. Detailed tests were performed on existing installations utilizing coal refuse filters to determine optimum flocculant dosage, solids concentration, and disc rotation speed to form a dischargeable cake. It was also confirmed that controlled additions of polymer flocculants will reduce filter refuse cake moisture somewhat. (Adapted from authors' Summary) D342, D423

D74-32 UNDERGROUND STORAGE OF COAL MINE WASTE

Kaufman, P. J. and McCuskey, J., Proceedings of the Fourth Mineral Waste Utilization Symposium, Chicago, Illinois, by U.S. Bureau of Mines and IIT

D74-32 (continued)

Research Institute, 1974. pp 275-283. These authors, both lawyers, discuss underground storage of refuse as a practical means of solving many problems. Pneumatic and hydraulic methods are discussed in detail in addition to integration of underground coal waste disposal with retreat mining methods and longwall methods. Abandoned mines are seen as good locations for disposal. Benefits and problems of underground storage included a rather significant cost but the overall results appeared to make this method very attractive. 622 M6

D74-33 REMOTE SENSING TECHNIQUES FOR ANALYSIS OF BURNING IN COAL REFUSE BANK

Knuth, W. M., Jr. (1) and Charmbury, H. B. (2) [(1) HRB-Singer, Inc. and (2) Mining Consultant], National Coal Association/Bituminous Coal Research, Inc., First Symposium on Mine and Preparation Plant Refuse Disposal Preprints, Louisville, Kentucky, 1974. pp 38-43. The technique uses a scan during aircraft flights to produce records on digital magnetic tapes which are analyzed through specially designed computer programs. The analyses permit inventory of burning refuse banks and monitoring the success of projects to extinguish refuse bank fires. D447

D74-34 EFFECT OF MULCHES AND AMENDMENTS ON THE SURVIVAL AND GROWTH OF VEGETATION PLANTED ON ANTHRACITE PROCESSING WASTES

Kusko, M., Jr. and Hutnik, R. J., The Pennsylvania State University, School of Forest Resources, Special Research Report, SR-101 (1974). 86 pp. Field experiments were conducted on two refuse sites in the Pennsylvania anthracite region: one, a large sludge dam which had been covered with large breaker refuse; and the other, a smaller sludge dam near a refuse bank. The purposes of the study were to determine the quantitative effect of various mulches on the moisture content and temperature of the refuse and the effect of various mulches and lime-fertilizer treatment on establishment and growth of trees, grasses, and legumes. 662.6 P4

D74-35 STATE-OF-THE-ART IN EXTINGUISHING REFUSE PILE FIRES

Magnuson, M. O. and Baker, E. C. (U.S. Bureau of Mines), National Coal Association/Bituminous Coal Research, Inc., First Symposium on Mine and Preparation Plant Refuse Disposal Preprints, Louisville, Kentucky, 1974. pp 165-182. In discussing the causes of refuse fires, it is pointed out that air circulation through the pile not only supplies oxygen but carries heat that can build up until ignition results. Methods of refuse pile construction to minimize air circulation and prevent fires are suggested. Extinguishing refuse fires by sealing the pile or by injecting fly ash slurry are described as is the most successful method, digging-out and cooling. D459

D74-36 COAL WASTE CAN BECOME AN ASSET

Maneval, D. R., Coal Mining & Processing 11 (2), 34-37 (1974). The problem of coal refuse disposal and efforts in the United States and Europe to use or reclaim it are reviewed. D313

D74-37 RECENT FOREIGN AND DOMESTIC EXPERIENCE IN COAL REFUSE UTILIZATION

Maneval, D. R. (Appalachian Regional Commission), National Coal Association/Bituminous Coal Research, Inc., First Symposium on Mine and Preparation Plant Refuse Disposal Preprints, Louisville, Kentucky, 1974. pp 256-262. The use of refuse in a variety of construction materials and as a landfill material is discussed. D466

D74-38 UTILIZATION OF COAL REFUSE FOR HIGHWAY BASE OR SUBBASE MATERIAL

Maneval, D. R. (Appalachian Regional Commission), Proceedings of the Fourth Mineral Waste Utilization Symposium, Chicago, Illinois, by U.S. Bureau of Mines and IIT Research Institute, 1974. pp 222-227. The British experiments with refuse and its utilization, especially as road building material, are reviewed. Pennsylvania's and West Virginia's refuse utilization programs are noted and suggestions are made for future refuse utilization in the United States. 622 M6

D74-39 QUALITY OF EFFLUENTS FROM COAL REFUSE PILES

Martin, J. F. (U.S. EPA, National Environmental Research Center, Cincinnati, Ohio), National Coal Association/Bituminous Coal Research, Inc., First Symposium on Mine and Preparation Plant Refuse Disposal Preprints, Louisville, Kentucky, 1974. pp 26-37. Effluents from refuse piles in Pennsylvania, West Virginia, Kentucky, and Indiana were sampled in the spring of 1974 and results of water analyses are tabulated and compared with analyses from the literature including analyses of effluents in Illinois. Amounts of metal ions, and acidity and alkalinity, are related to the coal seams and their geochemical characteristics. Pollution is also related to refuse pile construction. Suspended sediment seems to be more of a pollution problem than acid or metals in an area covering southern West Virginia and eastern Kentucky. 74-51

D74-40 COAL BY-PRODUCTS CONSTITUTE HIGHWAY BASE

Mason, R. H., Coal Mining & Processing 11 (5), 45, 63 (1974). In experimental parking lot and driveway installations at the U.S. EPA Crown, West Virginia, Mine Drainage Field Site, coal refuse was used alone in an-18 inch base and as 75 percent of a mixture with fly ash in 12- and 15-inch bases. D340

D74-41 COAL MINE REFUSE: AN ENGINEERING MATERIAL

Moulton, L. K., Anderson, D. A., Seals, R. K., and Hussain, S. M. (West Virginia University, Department of Civil Engineering), National Coal Association/Bituminous Coal Research, Inc., First Symposium on Mine and Preparation Plant Refuse Disposal Preprints, Louisville, Kentucky, 1974. pp 1-25. Laboratory studies were carried out to characterize refuse from four

D74-41 (continued)

sites in West Virginia. Refuse from one of the areas was used experimentally as a base for parking lot pavement at the Crown Mine Drainage Control Field Site in West Virginia. Test results from that project are reported and show that refuse material may have potential for use as a construction material. D446

D74-42 MOUNTAINEER EXPERIMENT IS UNDER WAY

Green Lands 4 (3), 25 (Fall 1974). Consolidation Coal Company and U.S. Soil Conservation Service cooperated on a project to control water pollution from a coal refuse dump near the Williams Mine at Enterprise, Harrison County, West Virginia. An inactive slurry impoundment was filled with refuse, limestone and fertilizer were disked in, and grass seed applied. There was grass cover after one month. Jour

D74-43 CLOSED SYSTEM HYDRAULIC BACKFILLING OF UNDERGROUND VOIDS

Patterson, R. M. (The Dow Chemical Company, Dowell Division), National Coal Association/Bituminous Coal Research, Inc., First Symposium on Mine and Preparation Plant Refuse Disposal Preprints, Louisville, Kentucky, 1974. pp 161-163. This backfilling technique uses high velocity feed to fill mined-out areas. Projects to control subsidence in Rock Springs, Wyoming, and Scranton, Pennsylvania, are described. D457

D74-44 A FEDERAL VIEW OF THE COAL WASTE DISPOSAL PROBLEM

Peluso, R. G. (MESA), Mining Congress Journal 60 (1), 14-17 (1974). The Mining Enforcement and Safety Administration's program for inspecting coal refuse banks and for developing guidelines for coal waste embankment design and construction is reviewed. The article also describes and illustrates some of the conditions found and corrections recommended in the evaluation of about 400 sites in five states. D299

D74-45 ENGINEERING ENVIRONMENTAL AND ECONOMIC PLANNING FOR COAL REFUSE DISPOSAL

Poellot, J. H. and Almes, R. G. (E. D'Appolonia Consulting Engineers, Inc.), Water Resources Problems Related to Mining, American Water Resources Association, Proceedings No. 18, June 1974. pp 99-108. The discussion of the factors which must be considered in planning mining and refuse disposal include mining and preparation methods, transportation of refuse, and disposal area design and operation. A review of a study of site selection for a refuse disposal area at a new mine being developed in northern West Virginia is given as an example of the analysis that should be carried out. 628.2 H13

D74-46 PROBLEMS IN UNDERGROUND DISPOSAL IN ACTIVE MINES

Poundstone, W. N. (Consolidation Coal Company), National Coal Association/Bituminous Coal Research, Inc., First Symposium on Mine and Preparation Plant Refuse Disposal Preprints, Louisville, Kentucky, 1974.

D74-46 (continued)

6 pp. The characteristics of United States underground mines and mining practices that make return of refuse to mined-out areas economically unfeasible are discussed. The author advocates disposing of coal refuse in layered and compacted piles which are covered with topsoil, vegetated, and used as productive land. D458

D74-47 PHOTODEFORMATION MEASUREMENTS OF REFUSE PILE STRUCTURE MOVEMENTS

Powell, J. R., Reich, M., Steinberg, M., and Kopp, J. (Brookhaven National Laboratory), National Coal Association/Bituminous Coal Research, Inc., First Symposium on Mine and Preparation Plant Refuse Disposal Preprints, Louisville, Kentucky, 1974. pp 44-63. Computer scanning of film of marked mine interiors and adjacent structures such as refuse piles is described as a method that could be used to predict unsafe conditions. D448

D74-48 CLOSED CIRCUIT PREPARATION PLANTS AND SILT PONDS

Pritchard, D. T., Mining Congress Journal 60 (11), 30-33 (1974). Emphasis in the preparation practices at the Chisholm Mine in Kentucky and the Madison Mine in West Virginia is on the closed water circuit and the use of large silt ponds to remove particulates from the recirculated water. Several large ponds, at least equaling or exceeding thickener capacity, are necessary. The ponds are cleaned usually two or three times a year. D369

D74-49 RECONNAISSANCE SURVEY REPORT OF COAL-MINE REFUSE DUMPS AND IMPOUNDMENTS

W. A. Wahler & Associates, Report to Mining Enforcement and Safety Administration, Office of Technical Support, Feb. 1974. Vol. 1. State of Alabama, NTIS, PB-233 733. Vol. 2. State of Kentucky, NTIS, PB-233 734. Vol. 3. State of Ohio, NTIS, PB-233 735. Vol. 4. State of Pennsylvania, NTIS, PB-233 736. Vol. 5. State of Virginia, NTIS, PB-233 737. Vol. 6. State of West Virginia, NTIS, PB-233 738. Each site report contains data on ownership, location, dimensions, history, geology, hydrology and coal seam mined, type of mining, preparation plant process and equipment, materials involved, and rates of disposal. Both ground and aerial photographs illustrate particular features of each site. Five sites were surveyed in Alabama, 30 in Kentucky, 4 in Ohio, 24 in Pennsylvania, 14 in Virginia, and 49 in West Virginia. D362-D367

D74-50 SELF-LOADING SCRAPER MOVES REFUSE EFFICIENTLY AND INEXPENSIVELY

Coal Age 79 (6), 78-79 (1974). The Itmann Mining Company's use of a Wabco 333 FT self-loading scraper to relocate a refuse dump while handling currently produced refuse is described. D345

D74-51 INNOVATIONS IN TAILINGS DISPOSAL

Shields, D. H. (University of Ottawa), National Coal Association/Bituminous Coal Research, Inc., First Symposium on Mine and Preparation Plant Refuse

D74-51 (continued)

Disposal Preprints, Louisville, Kentucky, 1974. pp 86-90. Two designs used for refuse disposal at metal mines in Canada are described. In one system, waste material is discharged down-valley from a relatively low cross-valley dam. A low control structure at the downstream end of the system acts as a decant structure and controls the recycle water required by the plant. In the second system, there is a central discharge which results in much larger storage capacity because the central cone of material can build up higher than the low perimeter dam required to collect drainage. D451

D74-52 METHOD FOR TREATMENT OF COAL WASHERY WATERS

Shubert, R. H., U.S. Patent 3,856,668 (Dec. 24, 1974). 7 pp. In this method, coal is agglomerated by agitation with heavy hydrocarbon oil and removed from the washery water. The mineral fraction settles out leaving a clarified water stream. CE58

D74-53 APPLICATION OF PNEUMATIC STOWING IN UNITED STATES COAL MINES

Singh, M. M. (1) and Courtney, W. J. (2) [(1) Foundation Sciences, Inc. and (2) IIT Research Institute], AIME Annual Meeting, Dallas, Texas, Feb. 23-28, 1974. 32 pp. Also published as "Feasibility of pneumatic stowing in United States coal mines," Transactions of AIME 258, 232-239 (1975). Standard systems of pneumatic stowing are discussed, and stowing machines described. Although Bureau of Mines studies have been conducted, there is no pneumatic stowing in U.S. coal mines and only two non-coal operations are noted. Hazards of the process are outlined. Economics of the process are included and show a cost of $1.50 to $3.00 per ton of coal mined. d343

D74-54 SOLIDIFYING COLLIERY TAILINGS

Colliery Guardian 222 (2), 62-63 (1974). The Chemfix process developed by Environmental Sciences, Inc., of Pittsburgh, Pennsylvania, is described. Industrial waste, including coal washery water, can be treated to form a manageable solid material. Jour

D74-55 ESTABLISHING VEGETATION ON ACIDIC COAL REFUSE MATERIALS WITHOUT USE OF TOPSOIL COVER

Sorrell, S. T. (Consolidation Coal Company), National Coal Association/Bituminous Coal Research, Inc., First Symposium on Mine and Preparation Plant Refuse Disposal Preprints, Louisville, Kentucky, 1974. pp 228-236. The project was carried out at a 12 acre, inactive coal-slurry impoundment at Mountaineer Coal Company's Williams Mine at Enterprise, West Virginia. The amount of limestone and fertilizer needed to establish a permanent grass cover were determined by analyses of 10 representative samples of refuse. A suitable mixture of seeds was sown after grading and preparing the site. Germination and plant growth generally resulted in dense vegetation, although in several places where inadequate grading allowed water to accumulate for several days, vegetation was not established. D464

D74-56 A SURVEY OF THE OUTPUT AND CHARACTERISTICS OF REJECT MATERIAL FROM COAL WASHERIES IN NEW SOUTH WALES

Szpindler, G. à D. and Waters, P. L., CSIRO Mineral Research Laboratories, Division of Mineral Chemistry, Investigation Report 101 (April 1974). 6 pp.+ This survey, carried out in 1970-71, showed that 38 washery plants discarded about 5.8 million tons of both coarse and fine wastes. Information on both the quality and quantity of refuse produced was sought in investigating the suitability of fluidized-bed combustion for treating refuse. Data obtained are tabulated in an appendix. D386

D74-57 FLUIDIZED-BED COMBUSTION AS A SOLUTION TO THE ENVIRONMENTAL PROBLEMS OF COAL MINING WASTE

Szpindler, G. à D., Waters, P. L., and Young, C. C. (CSIRO, Division of Mineral Chemistry), Process Industries in Australia - Impact and Growth, National Chemical Engineering Conference 1974, Queensland, Australia, July 10-12, 1974. pp 391-403. The paper discusses the environmental problems arising from the current practice of accumulating washery rejects in large dumps, and indicates how these problems could be reduced by burning rejects in fluidized-bed incinerators. The performance of a 50 kg/h test rig, designed for this purpose, using five different samples of rejects, is described. The following points are discussed: the effects of air and fuel feed rates on bed temperature and how this may be controlled by direct and indirect water cooling; heat distribution under various conditions; entrainment of fly-ash; and properties of the burnt rejects and their potential uses. The purpose of this work was to determine optimum conditions and to gather design data for a large scale plant. (Authors' Summary) D433, CE321

D74-58 FLUIDIZED-BED COMBUSTION OF LOW GRADE FUELS

Szpindler, G. à D., Waters, P. L., and Young, C. C. (CSIRO, Division of Mineral Chemistry), Symposium on Changing Technology of Electrostatic Precipitation, Institute of Fuel Conference (Australian Membership), 1974. Paper 6. 15 pp. The effects of shale and water inerts on the calorific value of washery reject feed and on furnace temperatures theoretically attainable are discussed. The performance of an experimental fluidized-bed combustor burning washery reject with 67 percent ash is described, in particular the effects of the feed rates of air and fuel on bed temperature. Methods of controlling bed temperature by direct and indirect water cooling and by excess air are also described. CE47

D74-59 TAILING DAM SPILL ALERT WARNING SYSTEM

World Mining 27 (3), 51 (1974). A method which predicts the collapse of tailings or coal refuse dams by measuring acoustic emissions was developed at Drexel University. The sub-audible sounds produced by soil under stress are measured. Measurements made in the field are compared with those made in laboratory tests and obtained from properly designed dams to assess the safety of dams under investigation. D357

D74-60 COLLIERY SPOIL HEAP MATERIALS - TIME DEPENDENT CHANGES

Taylor, R. K., Ground Engineering 7 (4), 24-27 (July 1974). Spoil (coal refuse) in heaps is affected by various conditions which cause changes in character and particle size. Disintegration of refuse is related to its mineralogy, sedimentary structures, and slaking. Chemical weathering of unburnt heaps takes place in top layers of the heaps. Refuse is changed most by burning, and the causes of burning spoil and the characteristics of burnt spoil are described. Burning can affect shear strength and the differences between the shear strength of unburnt, partly burnt, and burnt spoil are discussed. D381

D74-61 SULPHATE SPECIES IN COLLIERY SPOIL BANKS

Taylor, R. K. and Hardy, R. G. (University of Durham), Institution of Mining and Metallurgy Transactions Section A 83, A123-A126 (1974). Sulfate derived from pyrite oxidation can react with available cations to form various mineral species. Examples of sulfate minerals found in various tips throughout Great Britain are tabulated. D416

D74-62 MANUFACTURING CERAMIC GOODS OUT OF MINING WASTES

Toyabe, Y., Matsumoto, G., and Kishikawa, H., Proceedings of the Fourth Mineral Waste Utilization Symposium, Chicago, Illinois, by U.S. Bureau of Mines and IIT Research Institute, 1974. pp 241-244. Coal mine washing debris was used with hard pottery stone containing FeS as an impurity to produce dense pottery materials of varying formulations for various products including heavy-weight anti-abrasive floor tiles. 622 M6

D74-63 COAL REFUSE REGULATIONS, STANDARDS, CRITERIA, AND GUIDELINES

Wahler, W. A. (W. A. Wahler & Associates), National Coal Association/Bituminous Coal Research, Inc., First Symposium on Mine and Preparation Plant Refuse Disposal Preprints, Louisville, Kentucky, 1974. pp 78-85. The background to the development of coal refuse legislation and the regulations in force and being proposed are reviewed. The conditions for effective implementation of coal refuse legislation are discussed. D450

D74-64 COAL WASTES: WHAT CAN BE DONE

Wahler, W. A., Coal Mining & Processing 11 (1), 71-74, 102, 104 (1974). This is a critical discussion of coal refuse disposal and methods used to prevent refuse embankment failures. It is pointed out that some methods meant to improve the stability of the refuse banks could actually contribute to failures, and that environmental and safety regulations administered by various government agencies overlap or are in conflict, compounding instead of alleviating the problem. Proposed federal and state regulations and existing state regulations are also discussed with emphasis on the difficulty of building safe embankments if regulations to be complied with are too specific and rigid. Criteria for obtaining the expertise of consultants are also set forth. Jour

D74-65 USE OF COAL MINE REFUSE AND FLY ASH AS A ROAD BASE MATERIAL

Wilmoth, R. C. and Scott, R. B. (U.S. EPA, Crown Mine Drainage Control Field Site), National Coal Association/Bituminous Coal Research, Inc., First Symposium on Mine and Preparation Plant Refuse Disposal Preprints, Louisville, Kentucky, 1974. pp 263-275. The project at EPA's Crown Mine Drainage Control Field Site in West Virginia is described. D467

D74-66 SURVEY OF COAL REFUSE BANKS AND SLURRY PONDS FOR THE INDIANA STATE LEGISLATURE USING AERIAL AND ORBITAL INVENTORY TECHNIQUES

Wobber, F. J. (1), Wier, C. E. (2), Leshendok, T. (3), and Beeman, W. (4) [(1) IBM Corporation, (2) Indiana Geological Survey, (3) Earth Satellite Corporation, and (4) Indiana Coal Association], National Coal Association/Bituminous Coal Research, Inc., First Symposium on Mine and Preparation Plant Refuse Disposal Preprints, Louisville, Kentucky, 1974. pp 64-77. The survey was carried out to make quickly available information on number, size, location, and environmental effects of refuse disposal sites to aid the State Legislature in developing plans for reclamation of coal refuse areas. Systematic analysis of aerial color infrared photographs at 1:120,000 scale provided dependable and accurate data by which to locate and environmentally assess over 200 coal refuse sites. These data, with industry and state statistics, were used to compute a general cost of reclamation for each site. A summary of the data by county is tabulated in this paper. (Adapted from authors' abstract) D449

1975

D75-1 UTILIZATION OF COAL MINE WASTE FOR STRATA CONTROL

Allen, A. S. (U.S. Bureau of Mines), Proceedings, First Kentucky Coal Refuse Disposal and Utilization Seminar, University of Kentucky, Institute for Mining and Minerals Research, IMMR9-PD7-75 (1975). pp 18-24. The Bureau of Mines has worked to develop a pumped-slurry process to reduce subsidence in the anthracite region. Dilute slurry of coal refuse is pumped through a closed injection system from a mixing tank through a pumping unit and large-diameter distribution pipeline and injection boreholes to the mine workings. (From author's abstract) D409

D75-2 COAL WASTE DISPOSAL TO ELIMINATE TAILINGS PONDS

Anderson, J. C. (U.S. Steel Corporation), Mining Congress Journal 61 (7), 42-45 (1975). Several methods of dewatering waste from coal preparation plants, as well as chemical and cementation solidification of thickener underflow, are discussed as alternatives to disposal of refuse in dams and slurry ponds. Jour

D75-3 COAL REFUSE DISPOSAL PRACTICES IN THE AMERICAN COAL INDUSTRY

Barthauer, G. L. (Consolidation Coal Company), Proceedings of the Polish-U.S. Symposium on Environmental Protection in Openpit Coal Mining, by U.S. EPA and Central Research and Design Institute for Opencast Mining, Poland (POLTEGOR),

D75-3 (continued)

Denver, Colorado, May 27-29, 1975. Published by University of Denver Research Institute, Sept. 1975. pp 29-35. NTIS, PB-249 300. The author describes the development of methods of disposal of fine refuse removed from the preparation plant water circuit and of coarse material reject. 75-30

D75-4 LOCAL PROBLEMS AND RESEARCH NEEDS FOR OPTIMUM DISPOSAL AND UTILIZATION OF COAL REFUSE

Boyd, W. T. (U.S. Bureau of Mines, Kentucky Liaison Office), Proceedings, First Kentucky Coal Refuse Disposal and Utilization Seminar, University of Kentucky, Institute for Mining and Minerals Research, IMMR9-PD7-75 (1975). pp 36-37. The author emphasizes the current magnitude of the waste disposal problem and the projected increase of the problem as coal mining increases in the future. Because of environmental problems from refuse stored on the surface, he urges the development of technology for reliable underground disposal. D412

D75-5 COAL WASTE BANK PARAMETERS GIVEN IN NEW USBM REPORT

Busch, R. A., Backer, R. R., and Atkins, L. A. (U.S. Bureau of Mines), Coal Mining & Processing 12 (7), 52-55 (1975). The authors' Bureau of Mines report, RI 7964, "Physical Property Data on Coal Waste Embankment Materials" is summarized. Jour

D75-6 PHYSICAL PROPERTY DATA ON FINE COAL REFUSE

Busch, R. A., Backer, R. R., Atkins, L. A., and Kealy, C. D., U.S. Bureau of Mines, Spokane Mining Research Center, RI 8062 (1975). 40 pp. These data, developed on the fine coal waste materials that make up the core areas of two typical coal waste impoundments, will help define more completely the engineering properties of this problem area of the structures. Additional calorific, chemical, and mineralogical data were obtained on the coal waste materials to determine possible uses or development of byproducts. The possibility of extracting alumina from coal ash was also investigated. (From authors' abstract) BurM

D75-7 COAL WASTE STABILIZATION BY ENHANCED VEGETATION

Capp, J. P., Gillmore, D. W., and Simpson, D. G. (U.S. Bureau of Mines), Mining Congress Journal 61 (5), 44-49 (1975). Also published in Proceedings of the Polish-U.S. Symposium on Environmental Protection in Openpit Coal Mining, by U.S. EPA and Central Research and Design Institute for Opencast Mining, Poland (POLTEGOR), Denver, Colorado, May 27-29, 1975. Published by University of Denver Research Institute, Sept. 1975. pp 125-136. NTIS, PB-249 300. The U.S. Bureau of Mines reclamation program on the use of fly ash as a stabilizing and vegetation agent for surface mine spoil, refuse dumps, and gob piles is described. The 13 test sites and the power plants providing the fly ash are identified. Analyses of fly ash for a number of major elements and several trace elements are tabulated. Some conclusions from the work are that vegetation can be established on coal waste areas with

D75-7 (continued)

the use of fly ash; that weathering of fly ash-spoil mixture improves the success of revegetation; and that tree plantings are more effective after ground cover of grasses and legumes has been established. Costs are also discussed. Jour, 75-30

D75-8 ESTIMATING THE ACID POTENTIAL OF COAL MINE REFUSE

Caruccio, F. T. (University of South Carolina), in "The Ecology of Resource Degradation and Renewal," M. J. Chadwick and G. T. Goodman, Eds., London: Blackwell Scientific Publications, 1975. pp 197-205. Since it has been shown that fine-grained, or framboidal, pyrite is most readily decomposed to form acid, the method described here for estimating acid potential of a sample is based on determining what proportion of total pyrite is in the framboidal form. Samples are crushed, cast into plastic pellets which are polished and examined with an oil immersion lense. A calculation is made of that part of the total pyrite area of the pellet that is composed of the fine-grained form. 631 C43

D75-9 HEAT DRYING SLUDGE FROM PONDS

Casali, J. T., Mining Congress Journal 61 (1), 34-37 (1975). When Hawley Coal Mining Corporation settling ponds were full, with no expansion possibilities, the company decided to reclaim the sludge using a Jeffrey HMV dryer and cooling vibrator unit used with non-coal materials. Twenty-three tons/hr salable material was produced using a feed material of 19 percent moisture. Product moisture was 7.5 percent. Main problems overcome in setting up the unit were in preparing and feeding material from the ponds and in controlling stack emissions. Jour

D75-10 UTILIZATION OF PENNSYLVANIA ANTHRACITE REFUSE

Charmbury, H. B. (The Pennsylvania State University, College of Earth and Mineral Sciences), Proceedings, First Kentucky Coal Refuse Disposal and Utilization Seminar, University of Kentucky, Institute for Mining and Minerals Research, IMMR9-PD7-75 (1975). pp 13-17. Most uses of anthracite refuse are in producing materials for building and construction. Refuse was also successfully used as a soilless growing medium in trials at the Floriculture Department, Pennsylvania State University. D408

D75-11 COAL MINE REFUSE DISPOSAL

W. A. Wahler & Associates, Project Summary 325 (Jan. 1975). 4 pp. This summarizes a project in which 160 potentially hazardous coal refuse disposal sites in the Appalachian coal fields were investigated between March 1972 and December 1973. D387

D75-12 A STUDY OF COAL-ASSOCIATED WASTES RESULTING FROM THE MINING, PROCESSING AND UTILIZATION OF COAL: LITERATURE SURVEY--COAL ASSOCIATED WASTES (1900-1972)

Coalgate, J. L., West Virginia University, Coal Research Bureau, Interim Report No. 2 to U.S. Energy Research and Development Administration, FE-1218-T-1 (Aug. 1, 1975). (120 pp.) Included in this annotated bibliography that covers the world literature are 55 references in Section B: Utilization of Coal Mining Refuse; 70 references in Section C: Utilization of Coal Refining and Preparation Wastes; and 45 references in Section D: Utilization of Shale. OCR W5 75-2

D75-13 LITERATURE SURVEY - COAL ASSOCIATED WASTES (1900 - 1972)

Coalgate, J. L., West Virginia University, Coal Research Bureau, Report No. 115 (undated). (108 pp.) All wastes related to coal mining, beneficiation, and use are covered in the eleven sections of this bibliography. A total of one hundred references are listed in Section B: Utilization of Coal Mining Refuse, and in Section C: Utilization of Coal Refining and Preparation Wastes. 662.6 W521 115

D75-14 THE FLUIDISED COMBUSTION OF LOW-GRADE MATERIALS

Cooke, M. J. and Hodgkinson, N., in "Fluidised Combustion," An International Conference, Imperial College, London, U.K., Sept. 16-17, 1975, Institute of Fuel Symposium Series No. 1, 1975. C2-1 - C2-9. Work by the Coal Research Establishment, Great Britain, in evaluating coal refuse as a feed for fluidized combustion is reviewed in detail. 660 I95, CE958

D75-15 ELASTIC-PLASTIC STABILITY ANALYSIS OF MINE-WASTE EMBANKMENTS

Corp, E. L., Schuster, R. L., and McDonald, M. M., U.S. Bureau of Mines, RI 8069 (1975). 98 pp. This investigation presents a new method for analyzing the stability of mine-waste or tailings dams subjected to steady-state seepage; demonstrates the use of the technique in an actual field situation; and compares the accuracy of the method with that of conventional analysis techniques in an analysis of the Buffalo Creek dam failure. (Adapted from authors' Introduction) BurM

D75-16 INVESTIGATION OF MINING RELATED POLLUTION REDUCTION ACTIVITIES AND ECONOMIC INCENTIVES IN THE MONONGAHELA RIVER BASIN

Doyle, F. J., Chen, C. Y., Malone, R. D., and Rapp, J. R., Michael Baker, Jr., Inc., Report to Appalachian Regional Commission, under agreement with U.S. EPA, ARC-72-89/RPC-707 (1975). 416 pp. NTIS, PB-244 352-1WN. This study was performed to provide information on possible economically advantageous projects to abate water pollution related to mining. Pollution problems resulting from coal refuse piles are explored and the British and United States experience in dealing with them is reviewed. An inventory in Appendix A lists 333 coal refuse banks and tabulates their location, size, condition, and owner if known. Among the projects described for use of coal refuse are coal recovery, fill in highway and construction projects, and in surface mine

D75-16 (continued)

reclamation; and manufacturing of building materials. The results of a detailed laboratory investigation of the engineering properties of bituminous coal mine refuse are also included. CE21

D75-17 DESIGN AND CONSTRUCTION OF COAL REFUSE EMBANKMENTS: OCTOBER, 1975

Ellison, R. D. (E. D'Appolonia Consulting Engineers, Inc.), National Coal Association/Bituminous Coal Research, Inc., First Symposium on Underground Mining, Louisville, Kentucky, Oct. 21-23, 1975. 44 pp.+ This paper discusses two examples of site optimization that are being implemented: an impounding disposal site and a non-impounding site. Site and cost data are summarized for additional facilities to illustrate that safe and environmentally sound disposal can be realized for many conditions, at reasonable cost, with proper planning, design and implementation. Finally, areas where improvements could result in lower disposal costs or better disposal procedures are identified with suggestions for future studies. (From author's Introduction) D431

D75-18 ENGINEERING AND DESIGN MANUAL: COAL REFUSE DISPOSAL FACILITIES

E. D'Appolonia Consulting Engineers, Inc., Prepared for U.S. Department of Interior, Mining Enforcement and Safety Administration (undated). (830 pp.) Available, U.S. Government Printing Office, Stock Number 024-019-00012-8. Price $14.65 This Manual presents procedures for use in the design of coal refuse embankments in the United States. It serves as a uniform guide to safe refuse disposal practices by providing (1) experienced embankment design engineers with the characteristics of coal refuse and its disposal; (2) specialized technical knowledge concerning embankment design to engineers who do not specialize in this field; (3) a comprehensive view of disposal requirements and limitations for operators to efficiently include refuse disposal into the overall coal production operation; and (4) suggested minimum design storms and stability factors for a range of standardized embankment classifications. Environmental control and cost of disposal are both discussed along with procedures for selecting between alternatives for a variety of site conditions. (From Preface) 631 D21

D75-19 DRY SEPARATION OF COAL FROM WASTE MATERIAL

Fairbanks, H. V., West Virginia University, Coal Research Bureau, Report No. 116 (1975). 18 pp. Studies of two separation techniques were carried out. In one, screened particles were subjected to pressure designed to crush the softer particles, mainly coal, and not the harder material. The coal was separated by screening. The second technique used an inclined vibrating feeder. Both shape and density of crushed feed affected the separation of coal from unwanted material. D419

D75-20 METHOD AND APPARATUS FOR REDUCING SULPHUR AND ASH CONTENT OF COAL

Gay, L. T. (to C-G Process Coal Company), U.S. Patent 3,926,787 (Dec. 16, 1975). 12 pp. This method for recovering fine coal from coal refuse uses a hydrocyclone separator. USPat

D75-21 USEFUL MATERIALS FROM COLLIERY SPOIL

Gibson, J. (National Coal Board, Great Britain), Mine and Quarry 4 (8), 24, 29-30, 33 (1975). Several uses of colliery spoil material developed in England, where natural available aggregates are in limited supply, are described. Roadway fill is the most common use, with about 10 million tons sold up to 1972. Another use is a low-grade concrete made by mixtures of spoil, cement, and water. This product is used for parking areas and driveway sub-bases. One application now under development uses filter cake, and other fine colliery wastes to make blocks to be used as a substitute for wood chocks underground. Spoil can also be heat-treated to give a sinter product used as a lightweight aggregate. Jour

D75-22 INTERACTION OF LIMESTONE WITH THE MINERAL PART OF THE SULFUR-CONTAINING WASTES FROM COAL ENRICHMENT

Grekhov, I. T., Itkin, Yu. V., Cherkinskaya, K. T., and Shpirt, M. Ya., Solid Fuel Chemistry (Khimiya Tverdogo Topliva) 9 (5), 31-35 (1975). The authors investigated the process of roasting lime with high-sulfur coal refuse, such as that from Donetsk and Moscow coal basins, in order to produce high quality building materials and at the same time remove sulfur from the refuse. Among the findings of the study are that the main product of the roasting process is calcium sulfate; the optimum temperature for the process is about 950-1000 degrees C; and that at somewhat higher temperatures calcium sulfate will react with aluminosilicates in the refuse to form clinker aluminates, calcium aluminosilicates, and to liberate sulfur dioxide. Jour, CE628

D75-23 SOME PROPERTIES OF COAL SPOILBANK AND REFUSE MATERIALS RESULTING FROM SURFACE-MINING COAL IN ILLINOIS

Haynes, R. J. and Klimstra, W. D. (Southern Illinois University, Cooperative Wildlife Research Laboratory), Illinois Institute for Environmental Quality, IIEQ Doc. No. 75-21 (Oct. 1975). 126 pp. NTIS, PB-251 184. This publication reports the results of analyses of 2,084 spoil samples and 22 coal refuse samples collected during the 1970-71 survey of surface-mined land in Illinois. Although some surface materials from all mined areas yielded a pH of less than 4.1, most samples had a pH ranging from 5.1 to 8.1. Acid spoils showed properties deleterious to most vegetation. These properties included high exchangeable acidity and soluble salts; possibly toxic concentrations of soluble sulfate, iron, manganese, and aluminum; and low potassium, calcium, and base saturations. (Adapted from authors' Summary) R777

D75-24 PROBLEMS WITH UNDERGROUND REFUSE DISPOSAL

Kegel, W. G. (Jones & Laughlin Steel Corporation), Transactions of AIME 258, 280-283 (1975). Also presented at AIME Annual Meeting, Feb. 16-20, 1975. Preprint 75-F-67. 13 pp. General problems of handling refuse when hauling it back into the mine and of pneumatic and hydraulic stowing are discussed. Underground disposal is concluded to be the wrong method of dealing with coal refuse. Jour

D75-25 LOCAL GOVERNMENT INVOLVEMENT IN COAL REFUSE UTILIZATION: TECHNICAL MEMORANDUM

Kraus, A. (Kentucky Department of Finance and Administration), Proceedings, First Kentucky Coal Refuse Disposal and Utilization Seminar, University of Kentucky, Institute for Mining and Minerals Research, IMMR9-PD7-75 (1975). pp 34-35. The impact of local government on refuse disposal and utilization is achieved mainly through planning implemented by zoning regulations. D411

D75-26 MAKING MOUNTAINS IS EASY

The Consol News, Feb.-March 1975. p 12. Near Moundsville, West Virginia, a coal refuse disposal site used since 1958 by Consol's Ireland Mine is being reclaimed. The project, being carried out a section at a time, includes shaping, covering, and seeding the area, and controlling water runoff by diversion ditches. D385

D75-27 RECENT EUROPEAN PRACTICE IN COAL REFUSE UTILIZATION

Maneval, D. R. (Appalachian Regional Commission), Proceedings, First Kentucky Coal Refuse Disposal and Utilization Seminar, University of Kentucky, Institute for Mining and Minerals Research, IMMR9-PD7-75 (1975). pp 1-12. This paper discusses the occurrence, magnitude, properties, and utilization of coal mine refuse. The experience of the National Coal Board in marketing fresh and weathered refuse is highlighted. Suggestions are presented on how research and application may lead to increased acceptance and use of coal refuse. D407

D75-28 WATER BORNE POLLUTANTS FROM REFUSE PILES

Maneval, D. R. (Appalachian Regional Commission), National Coal Association/Bituminous Coal Research, Inc., First Symposium on Underground Mining Preprints, Vol. 2, Louisville, Kentucky, 1975. pp 210-219. Refuse can contribute to water pollution either through leaching of refuse piles by precipitation or through inadvertent overflow of preparation plant water. Various methods of refuse handling and disposal to prevent water pollution are described. D478

D75-29 WATER QUALITY ASPECTS OF COAL REFUSE UTILIZATION

Martin, J. F., Scott, R. B., and Wilmoth, R. C. (U.S. EPA, Industrial Environmental Research Laboratory, Cincinnati, Ohio), Proceedings, First Kentucky Coal Refuse Disposal and Utilization Seminar, University of Kentucky, Institute for Mining and Minerals Research, IMMR9-PD7-75 (1975). pp 25-28. An asphaltic concrete parking apron over refuse and refuse plus fly ash base courses has been installed at the Crown Mine Drainage Field Site, West Virginia. Results of monitoring the water quality of runoff showed that refuse alone contributed significant acidity, iron, and aluminum, and that refuse with fly ash and with fly ash and lime yielded only small amounts of acidity and metals. D410

D75-30 THE COAL OPERATOR'S PARTICIPATION IN COMMUNITY DEVELOPMENT

McDowell, C. D. (President, National Independent Coal Operators' Association), Proceedings, First Kentucky Coal Refuse Disposal and Utilization Seminar, University of Kentucky, Institute for Mining and Minerals Research, IMMR9-PD7-75 (1975). pp 38-39. The author reviews the development of the coal industry in Kentucky and the various uses that have been investigated for coal refuse. D413

D75-31 MINI-DREDGE SLURPS UP TONS OF WASTE COAL FROM SLURRY SETTLING PONDS

Coal Age 80 (1), 60-62 (1975). The Mud Cat, used by Peabody Coal Company for recovering coal from slurry ponds of coal processing plants, is described. D377

D75-32 MINIATURE DREDGE WILL RECLAIM 1,000,000 TONS OF COAL

World Coal 1 (1), 31 (1975). Peabody Coal Company's use of a small dredge, called The Mud Cat, to reclaim fine coal from a settling pond which covers about 100 acres is described. The recovered coal is pumped to a preparation plant at the rate of 40 tph and the cleaned product goes to a power plant. Jour

D75-33 METHOD OF TREATING COAL MINING REFUSE

Minnick, L. J., Smith, C. L., and Webster, W. C. (to IU Conversion Systems, Inc.), U.S. Patent 3,870,535 (March 11, 1975). 6 pp. Coal refuse containing sulfuric-acid-forming material is reacted with lime in the presence of moisture. The refuse can also be treated with a pozzolanically active material such as fly ash. The treatment forms a self-hardening material which may be used as a structural fill or as a road base material. Also, refuse piles can be treated in the same way to form a hard impervious surface, preventing water percolation. CE50

D75-34 RECLAIMING COAL FROM SLURRY PONDS

Morris, G. H. (Peabody Coal Company), Mining Congress Journal 61 (12), 38-40 (1975). The reclaiming methods used by Peabody Coal Company are recovery by end loader or dragline for use without any additional preparation or for blending with raw coal fed to the preparation plant; and recovery by Mud Cat dredge of slurry to be pumped to a specially designed coal cleaning plant. Jour

D75-35 NEW PLASTER HYDROSPRAYED ONTO COAL REFUSE SMOTHERS FIRES OR AIDS REVEGETATION

Coal Age 80 (7), 137 (1975). U.S. Gypsum has developed a unique solution for revegetating burning refuse piles. A specially processed and formulated gypsum plaster is mixed with regular hydroseeding materials and sprayed on refuse piles. The process has been successful in several areas in West Virginia including a burning refuse pile. Among advantages are that a neutral

D75-35 (continued)

pH is maintained, heat is reflected, spontaneous combustion is controlled, and it is more economical than using topsoil. D392

D75-36 COMBUSTION OF COLLIERY SHALE IN A FLUIDIZED BED

Norman, P. (University of Newcastle upon Tyne), Energy World No. 18, 2-4 (July 1975). In this experimental work, colliery shale was dried and crushed for combustion tests in a small fluidizing reactor. The shale would not burn unless additional fuel, such as propane or pulverized coal, was used. Bed temperatures were in the 800-900 C range. Details of air rates and supplemental fuels are given. The shale was burned out completely under these conditions. Jour

D75-37 MAKING THE GRADE IN COAL REFUSE DISPOSAL

Parker, W. W. and Gray, R. E. (GAI Consultants, Inc.), Coal Mining & Processing 12 (11), 38-42, 64 (1975). The factors critical to design of stable coal refuse disposal areas are discussed. The authors point out the most serious deficiencies they have found in their review of waste disposal plans submitted for approval by the Mining Enforcement and Safety Administration. Jour

D75-38 PEABODY RECLAIMS COAL FROM OLD SLURRY POND

Coal Mining & Processing 12 (2), 23 (1975). See also "Peabody Recovers Waste Coal at Bee-Veer Tailings Pond with Mud Cat Mining Machine," Mining Engineering 27 (2), 30 (1975). Pictured with this news note is the Mud Cat machine which is pumping slurry to the Bee-Veer Mine preparation plant in north central Missouri. Forty tons of coal per hour are being recovered and the water is returned to the impoundment. D383

D75-39 METHOD OF TREATING COAL REFUSE

Pelczarski, E. A., Karnavas, J. A., and LaRosa, P. J. (to Black Sivalls & Bryson, Inc.), U.S. Patent 3,917,795 (Nov. 4, 1975). 7 pp. The present invention relates to a method of treating coal refuse containing pyrites and ash to produce usable products therefrom. The coal refuse is mixed with lime or limestone, formed into pellets and heated to form pellets containing calcium sulfide. The pellets are then reacted with carbon dioxide and water to form hydrogen sulfide and a calcium carbonate bonded coherent product which may be used for a variety of commercial purposes. The hydrogen sulfide produced in the reaction is converted to saleable elemental sulfur. (Abstract of the disclosure) US Pat, CE808

D75-40 ENGINEERING PROPERTIES OF COAL WASTE EMBANKMENT MATERIAL

Peterson, R. (U.S. MESA), National Coal Association/Bituminous Coal Research, Inc., First Symposium on Underground Mining Preprints, Vol. 2, Louisville, Kentucky, 1975. pp 220-225. Although refuse characteristics are determined by tests used in the field of soil mechanics, the properties of refuse are

D75-40 (continued)

different from materials commonly considered as soils. Coal refuse properties discussed in this paper are gradation (amounts of various size particles), permeability, water content, consistency limits (water content that determines the liquid, plastic, or solid state of refuse), compaction and density, shear strength, and consolidation characteristics of an embankment. D479

D75-41 SPOIL HEAPS IN THE RUHR DISTRICT AND THEIR INTEGRATION INTO THE LANDSCAPE AS A MEASURE TO IMPROVE ENVIRONMENTAL CONDITIONS

Petsch, G. (Siedlungsverband Ruhrkohlenbezirk, Federal Republic of Germany), in "The Ecology of Resource Degradation and Renewal," M. J. Chadwick and G. T. Goodman, Eds., London: Blackwell Scientific Publications, 1975. pp 435-441. A summary of the condition of refuse disposal areas in the Ruhr is tabulated. Refuse disposal is controlled by government regulation, and design of disposal areas is planned so that landscaping and establishment of vegetation are being carried out while the area is being used. Coal refuse disposal areas also may be used for disposal of domestic and industrial waste. 631 C43

D75-42 PRESSURE FLUSHING SPEEDS BACKFILLING OF ABANDONED UNDERGROUND MINES

Coal Age 80 (1), 68-70 (1975). In this method, the refuse is crushed and slurried above ground. Surface pipelines then carry it to boreholes drilled into various sections of the abandoned mine. No men are required underground. The article describes a demonstration project in the Green Ridge Section of Scranton, Pennsylvania. The project is a continuation of work started in 1972 by Dowell Company. D378

D75-43 THE INFLUENCE OF PYRITE OXIDATION PRODUCTS ON THE ADSORPTION OF PHOSPHATE BY COAL-MINE WASTE

Pulford, I. D. and Duncan, H. J. (University of Glasgow), Journal of Soil Science 26 (1), 74-80 (1975). Coal waste materials tested to determine their ability to adsorb fertilizer phosphate showed that black shale (unburned) adsorbed more phosphate than red (burned) shale. Amorphous iron oxide, a product of pyrite oxidation, was found to be the most important factor in phosphate adsorption. Heating the refuse below 400 C increased the amount of phosphate adsorbed, while heating the refuse above 400 C decreased phosphate adsorption, possibly because of crystallization of the amorphous iron oxide. The refuse used in the study was taken from four sites in central Scotland. CE272

D75-44 PREDICTING THE POTENTIAL ACIDITY IN RECLAIMED COAL MINE WASTE

Pulford, I. D. and Duncan, H. J. (Glasgow University), Surveyor 145 (4312), 36-37 (Jan. 31, 1975). Refuse material is classified into five categories depending on the amount of acidity which can be generated by the material. A high sulfate content of the refuse is an indication that it has low potential acidity. The authors note that if the acidity which can be generated can be predicted, techniques can be used to prevent conditions unfavorable for growth of vegetation on reclaimed refuse piles. R1012

D75-45 "THAR'S COAL IN THEM THAR TIPS ---,"

Read, C. P., Mine and Quarry 4 (9), 52-56 (1975). The use of heavy-duty, high-power wheeled loading shovels to recover coal from long neglected colliery waste in England's North East is described. John Deere turbo charged, four-wheel drive loading shovels handle several thousands tons per day of waste to recover usable coal. The machines are working 84 hours a week and are expected to last about four years. Removal of the piles is also an environmental asset. Jour

D75-46 OPENCAST AND PLANT IN THE NORTH-EAST

Read, C. P., Mine and Quarry 4 (10), 32, 35 (1975). The John Deere Company loader JD644A handles 6 tons at a time. Its use for handling waste for coal recovery and transporting coal is described. The loader can operate on the public roads, saving the cost of extra outside equipment. Detailed specifications for the loader are included as well as descriptions of its special design features. Jour

D75-47 PHYSICAL PROBLEMS OF GROWING PLANTS ON COLLIERY WASTE

Richardson, J. A. (University of Newcastle upon Tyne, England), in "The Ecology of Resource Degradation and Renewal," M. J. Chadwick and G. T. Goodman, Eds., London: Blackwell Scientific Publications, 1975. pp 275-285. Particle size of refuse and its silt and clay content affect water infiltration, water holding capacity, compaction, crusting, and surface erosion of refuse piles. These characteristics and the lack of organic content in coal wastes contribute to the difficulty of establishing vegetation on the refuse. Three different aged refuse piles from similar material are compared. As weathering increased the amount of fine particles, some plant growth could occur, thus building up organic matter in the soil. The loss of fine particles by wind or storm run-off retards establishment of vegetation. Studies carried out in County Durham, England, are described. 631 C43

D75-48 FEDERAL INTEREST IN COAL MINE WASTE DISPOSAL

Schlick, D. P., U.S. Department of Interior, Mining Enforcement and Safety Administration, IR 1023 (1975). 15 pp. This publication reviews the history of mine waste disposal at coal mines and documents the actions taken by the Federal Government to assure the stability of coal mine waste embankments behind which water may be intentionally or inadvertently impounded and thus prevent occurrences like the Buffalo Creek flood disaster that occurred at Saunders, W. Va., on February 26, 1972. Appended to the publication are rules issued by the Secretary of the Interior amending those Mandatory Safety Standards for Surface Coal Mines and Surface Work Areas of Underground Coal Mines (30 CFR Part 77) that pertain to coal mine waste impoundments. (Author's abstract) MESA

D75-49 RECLAMATION OF ANTHRACITE COAL REFUSE USING TREATED MUNICIPAL WASTEWATER AND SLUDGE

Sopper, W. E., Kardos, L. T., and DiLissio, L. E., The Pennsylvania State

D75-49 (continued)

University, Institute for Research on Land and Water Resources, Research Project Technical Completion Report to U.S. Department of Interior, Office of Water Research and Technology, April 1975. 168 pp. NTIS, PB-243 114/6WN. The objectives of this study were to evaluate the vegetative growth responses and chemical changes of the refuse and percolate resulting from the application of heated municipal sewage effluent and liquid digested sludge to anthracite coal processing refuse. The results of the study indicated that revegetation of anthracite coal refuse is possible through the application of treated municipal wastewater. In general, the effluent and sludge improve the chemical characteristics of the refuse and provide an abundant source of nutrients for the vegetation. (From authors' Summary and Conclusions) D434

D75-50 WASTE DAM REGULATIONS AND LABORATORY

Stanin, S. A. (U.S. MESA), National Coal Association/Bituminous Coal Research, Inc., First Symposium on Underground Mining Preprints, Vol. 2, Louisville, Kentucky, 1975. pp 206-209. The author discusses the development of guidelines for coal refuse disposal, and the need for data on the physical and engineering characteristics of refuse in evaluating plans for construction of refuse embankments. D477

D75-51 THE ROLE OF EARTH COVER DEPTHS AND UPWARD ACID DIFFUSION ON THE SURVIVAL AND DISTRIBUTION OF VEGETATION ON COAL REFUSE PILES

Sukthumrong, A., University of Illinois at Urbana-Champaign, Ph.D. Thesis, 1975. 126 pp. The study of chemical alterations in coal refuse composition caused by weathering was carried out on eight old and recent refuse piles in Illinois. Six refuse piles in Macoupin Co., one in Montgomery Co., and one in Fulton Co. were selected and sampled in 1974. Water extracts of samples from these piles were analyzed for pH, percent total sulfur, titratable acidity (TA), total dissolved solids (TDS) and for water-soluble and 1 N KCl extracts. The results show that recent refuse piles are highly acidic and capable of producing substantially more acid runoff water than old refuse piles. Total sulfur contents show that old and recent refuse piles are extremely heterogeneous bodies. The water-soluble Fe and Al in recent refuse materials greatly exceeds that of old weathered refuse but the reverse is true for water-soluble Ca. It appears that both recent and old weathered coal refuse piles are reclaimable if adequate lime is applied although the immediate lime requirements are much higher for recent refuse piles than for old refuse piles. The immediate lime requirements can be estimated from the sum of the water-soluble and KCl extract TA values, and the amount of lime required to neutralize potentially oxidizable pyritic sulfur, calculated from the hydrogen peroxide oxidizable sulfur present. An earth-covered refuse pile, south of Pana, Illinois, was studied to determine the depth distribution of total sulfur, the various sulfur fractions, and other constituents as indicators of progressive upward acid diffusion, and to study the upward acid diffusion patterns as these relate to the survival vegetation for evaluating the long-term effectiveness of the earth covering practice. Soil and refuse samples were collected according to the apparent density and distribution of vegetation. The samples were analyzed for pH, electrical conductivity (EC),

D75-51 (continued)

TA, total sulfur content, amount of sulfur fractions, total water-soluble cations. Visual observation indicated that portions of the vegetative cover at the Pana refuse pile were deteriorating due to surface acidification and erosion. A considerable amount of acid water is being discharged as basal seepage from the pile. Chemical analysis indicated that the earth mantle at Pana has been strongly acidulated by the upward diffusion of soluble acidic products from the underlying refuse materials. To study reclamation of refuse piles, a number of plots at Peabody Coal Company's Atkinson and Will Scarlet refuse piles in Illinois were variously treated with lime and seeded. No vegetation grew on the zero lime plots. Vegetation varying from fair to good in vigor occurred on high lime rate plots at both locations but vegetative vigor tended to be more regular within treatments at Atkinson than at Will Scarlet. Fescue and bromegrass appear to be superior to switchgrass at both locations. Water extracts of samples from these plots were analyzed for pH, TA, EC, TDS, residual $CaCO_3$, total sulfur and various sulfur fractions. All lime rates substantially increased the pH and reduced the amount of titratable acidity. The total dissolved solids and the total sulfur content of the lime plots was greater than that for the unlimed plots which possibly is a reflection of higher concentrations of soluble hydrolyzable Fe and Al sulfates in the unlimed plots. (Adapted from author's Summary and Conclusions) 631 S94, CE612

D75-52 SUPER SIZE IMPOUNDMENT IS APPROVED

The Consol News, Feb.-March 1975. p 10. An "overdesigned" impoundment and concrete spillway recently installed at Consol's Shoemaker Mine near Benwood, West Virginia, is described. The spillway will handle a peak flow of 2.5 million gallons a minute. The impoundment walls are built of coal refuse material which is so compacted that water cannot penetrate it. The slurry rate into the impoundment is currently 100 gal/min. Fines are removed by froth flotation thereby reducing solids entering the impoundment. D384

D75-53 INVESTIGATION OF POTENTIAL FOR HEAT AND MATERIAL RECOVERY IN THE FLUIDIZED-BED INCINERATION OF COAL WASHERY REJECTS AND SOME OTHER INDUSTRIAL WASTES

Szpindler, G. à D. and Waters, P. L. (CSIRO Mineral Research Laboratories, Australia), Proceedings, First International Conference on Conversion of Refuse to Energy, Montreux, Switzerland, Nov. 3-5, 1975. pp 313-319. This paper discusses the heat balance of the combuster and the influence of the type of bed (fluidized versus spouting) and fuel (coarse rejects, slurries, and liquid wastes) on heat recovery. Methods of controlling bed temperature, such as variations in air-fuel ratio, direct water quenching, and insertion of water-cooled tubes, and their effect on heat recovery are also discussed. Finally, the properties of the burnt rejects and their potential uses are described. (From authors' abstract) CE229

D75-54 RECLAMATION OF DERELICT LAND AT STOKE-ON-TRENT

Tandy, C. R. V. (Land Use Consultants, London, England), in "The Ecology of Resource Degradation and Renewal," M. J. Chadwick and G. T. Goodman, Eds., London: Blackwell Scientific Publications, 1975. pp 421-427. Refuse piles are one of the kinds of derelict lands reclaimed to forest parks and pedestrian walkways. 631 C43

D75-55 ENGLISH AND WELSH COLLIERY SPOIL HEAPS - MINERALOGICAL AND MECHANICAL INTERRELATIONS

Taylor, R. K., Engineering Geology 9, 39-52 (1975). Seventy-four post-failure triaxial test specimens from fifteen colliery spoil heaps in England and Wales have been chemically and mineralogically analysed. Three mineral groupings emerged from statistical correlations: clay-minerals, coal and carbonates, with the coal group showing strong inverse relationships with the clay-minerals group. Correlation matrices of physical and mechanical properties versus mineralogical and chemical components have enabled the main mineralogical controls on the physical characteristics to be recognized. Coal is believed to be a major factor which influences not only peak shear strength, but fundamental properties such as natural moisture content, plastic limit and indirectly bulk density which correlates positively with the clay-minerals. (Author's abstract) D426

D75-56 TECHNOLOGICAL INNOVATIONS ABOUND IN COAL MOUNTAINS OF APPALACHIA: RECLAIMING COAL FROM REFUSE PONDS

Coal Age 80 (6), 273-274 (1975). Coal is recovered from slurry ponds at Peabody Coal Company's Bee Veer mine with a Mud Cat mini dredge. Jour

D75-57 UNDERGROUND DISPOSAL OF COAL MINE WASTES

National Academy of Sciences, Study Committee to Assess the Feasibility of Returning Underground Coal Mine Wastes to the Mined-Out Areas, Report to National Science Foundation, 1975. 172 pp. Available, Printing and Publishing Office, National Academy of Sciences, 2101 Constitution Avenue, N.W., Washington, D.C. 20418. Although the focus of this report is on the technical and economic feasibility of coal waste disposal in mine voids, the legal parameters are considered. Differentiation is made between backfilling in active and in abandoned mines. European experience and requirements are noted. Appendixes include a glossary; a discussion of the effects of mixing and backfilling on subsidence and roof control; the basis of cost estimates; and excerpts from regulations on coal waste disposal. D389

D75-58 REGULATORY CONTROL, DESIGN APPROVAL, AND CONSTRUCTION INSPECTION OF COAL REFUSE EMBANKMENTS

Wahler, W. A. and Perry, C. W. (W. A. Wahler & Associates), National Coal Association/Bituminous Coal Research, Inc., First Symposium on Underground Mining Preprints, Vol. 2, Louisville, Kentucky, 1975. pp 227-241. The purpose of this paper is to describe the regulation of dam safety in those states where it is highly developed in order to promote the understanding of

D75-58 (continued)

the specialized regulatory system being evolved by MESA to control the safety of coal refuse banks. D480

D75-59 PRODUCING LIGHTWEIGHT AGGREGATE

Warnke, W. R., U.S. Patent 3,909,283 (Sept. 30, 1975). 3 pp. Coal refuse is one of the many waste products covered by this patent. Refuse material, mixed with a small amount of limestone and coal, is pelletized and fired in a rotary kiln to about 2200 F for five minutes. The carbon dioxide evolved from the limestone causes the pellets to expand. USPat, CE290

D75-60 HYDRA-SLUDGE REMOVAL SYSTEM FOR MINE DRAINAGE AND COAL PREPARATION PLANT SLUDGE

Werner, R. H. (Barrett Haentjens and Company), AIME Annual Meeting, New York, New York, 1975. Preprint No. 75-F-83. 13 pp. This automatically controlled commercial pumping system, which will hydraulically remove sludge materials from a settling pond or thickener, is described. 75-13

D75-61 PUMPED-SLURRY BACKFILLING OF INACCESSIBLE MINE WORKINGS FOR SUBSIDENCE CONTROL: WITH AN APPENDIX ON HYDRAULIC MODEL STUDIES FOR BACKFILLING MINE CAVITIES

Whaite, R. H., Allen, A. S., and Carlson, E. J., U.S. Bureau of Mines, IC 8667 (1975). 83 pp.+ A full-scale demonstration of subsidence control by pumped-slurry backfilling was completed in 1973 in Scranton, Pennsylvania, which is underlain by abandoned anthracite mines in several coalbeds superposed one above another. A 30-acre residential area was stabilized by injecting about 450,000 cubic yards of crushed mine refuse into two coalbeds through five injection boreholes. Nearly 200,000 cubic yards was injected through one borehole from which the material moved into the mine workings on all sides; the injected material reached a maximum lateral distance of 640 feet and filled mine openings from floor to roof. The new method, designed for inundated mines, proved successful also in mine workings about mine-water pool level. Distribution of slurry through a buried pipeline minimized disturbance to the community. (From authors' abstract) BurM, CE636

D75-62 PRELIMINARY REPORT ON FLUID-BED COMBUSTION OF ANTHRACITE WASTES

Wilson, J. S. and Gillmore, D. W. (U.S. Energy Research and Development Administration, Morgantown, West Virginia), in "Proceedings of the Fourth International Conference on Fluidized-Bed Combustion," McLean, Virginia, sponsored by U.S. Energy Research and Development Administration, coordinated by MITRE Corporation, Dec. 9-11, 1975. pp 55-67. The combustibility characteristics of two anthracite refuse materials were examined by the Morgantown Energy Research Center. The refuse was found to be an acceptable feedstock for fluidized-bed combustors and the carbon (or fuel) value of the material was easily recovered. 660 I64, CE637

D75-63 ENGINEERING EVALUATION OF COAL REFUSE SLURRY IMPOUNDMENTS

Zook, R. L., Olup, B. J., Jr., and Pierre, J. J. (L. Robert Kimball, Consulting Engineers), AIME Annual Meeting, Dallas, Texas, Feb. 23-28, 1974. Preprint No 74-F-39. 25 pp. Also published in Transactions of AIME 258 (1), 55-61 (1975). Eight existing impoundments were studied and four dams using coarse refuse have been designed. Engineering properties of coal refuse, including grain size distribution, compaction, permeability, and shear strength are discussed, as are hydrologic and hydraulic analysis parameters, and site evaluations. The factors affecting the stability of dams are pointed out. D344

1976

D76-1 AERIAL TRAMWAYS EFFICIENTLY DISPOSE OF REFUSE FROM COAL PREPARATION PLANTS

Coal Age 81 (1), 167-168 (1976). Several types of tramways and their operation are described. Jour

D76-2 OPTIMIZING DISPOSAL OF COAL REFUSE AND ASH WASTES FOR A MINE-MOUTH ELECTRICAL GENERATING STATION FACILITY

Almes, R. G. (E. D'Appolonia Consulting Engineers, Inc.), Proceedings of the Fifth Mineral Waste Utilization Symposium, Chicago, Illinois, by U.S. Bureau of Mines and IIT Research Institute, 1976. pp 98-106. Coal from a new mine and preparation plant will be used in the Mt. Storm Electrical Generating Station in northern West Virginia. The study to select a site for disposal of coal refuse and the final design of the disposal area are described. Both bottom ash and fly ash will also be incorporated in this area. The use of ash is expected to help control drainage through the refuse. 622 M6

D76-3 SURFACE AND UNDERGROUND DISPOSAL OF COAL MINE WASTES. PART 1: COAL WASTE PRODUCTION, SURFACE DISPOSAL AND REGULATION; PART II - UNDERGROUND DISPOSAL

Atwood, G., Part 1, Underground Space 1 (2), 111-121 (1976). Part II, Underground Space 1 (3), 261-281 (1977). These articles are based on the report "Underground Disposal of Coal Mine Wastes," published by the National Academy of Sciences in 1975. CE610, CE611

D76-4 PHYSICAL AND ENGINEERING CHARACTERISTICS OF COAL PREPARATION PLANT REFUSE

Bishop, C. S. and Rose, J. G. (University of Kentucky), "Proceedings of the Seventh Ohio River Valley Soils Seminar on Shales and Mine Wastes: Geotechnical Properties, Design, and Construction," Lexington, Kentucky, by ASCE Kentucky Section Soil Mechanics and Foundation Group and Cincinnati-Dayton Geotechnical Group, University of Kentucky, University of Cincinnati, University of Louisville, and Kentucky Department of Transportation, Oct. 8, 1976. pp 4-1 - 4-11. During the spring of 1975 a

D76-4 (continued)

study was made of the refuse at the South-East Coal Company preparation plant in Estill County, Kentucky. Shear-strength testing was performed with a Dutch cone penetrometer for the purpose of evaluating the in-place coal refuse in the waste embankment. Laboratory testing consisted of typical soil classification tests along with moisture-density, bearing ratio, permeability, and triaxial testing of compacted specimens. Coal analyses and mineralogical studies were performed in order to determine the inherent composition of the waste material. Results of these tests are summarized. Significant variations from typical values for soils were noted. Moisture-density relationships also varied over a wide range, with dry unit weights varying from 81 pcf to 115 pcf. These values are consistently lower than those for soils with similar classifications. Values determined for the effective angle of shearing resistance are also consistently lower than those for typical soils. Although the detailed testing program was undertaken at only one site, basic soil mechanics tests were performed on disturbed samples from several other refuse sites in Kentucky. Results of these tests indicate that a wide range of variability exists between plants due to characteristics of the coal seam being mined, preparation processes used, and disposal methods practiced. (From authors' abstract) CE920

D76-5 SELECTED SOIL MECHANICS PROPERTIES OF KENTUCKY COAL PREPARATION PLANT REFUSE

Bishop, C. S. and Simon, N. R. (University of Kentucky), Proceedings of the Second Kentucky Coal Refuse Disposal and Utilization Seminar, University of Kentucky, Institute for Mining and Minerals Research, IMMR21-PD15-76 (1976). pp 61-67. The geological-mineralogical background of coal refuse is discussed. Determinations of grain size, moisture, and specific gravity were carried out on 18 refuse samples from a number of Kentucky coal preparation plants and an attempt was made to classify the refuse using criteria for soil classification systems. The California Bearing Ratio Test and analyses of shear strength were carried out to determine the engineering properties of the refuse. Results of the testing program showed that coal refuse varies greatly from plant to plant and each source of refuse should be evaluated separately to determine how it should be used. CE203

D76-6 COAL'S ULTIMATE PROBLEM CAN BE AN OPPORTUNITY

Blakely, J. W., Coal Mining & Processing 13 (8), 42-45 (1976). The problem of disposing of coal mining refuse, especially the high moisture fines which tend to flow, is discussed. Some solutions to the problem lie in using engineering techniques in developing refuse disposal sites, the use of coarse refuse in construction projects, and the adaptation of high-pressure filter plates to dewatering fine refuse. Jour

D76-7 KENTUCKY COAL PREPARATION PLANT REFUSE CHARACTERIZATION AND USES

Bland, A. E., Robl, T. L., and Rose, J. G. (University of Kentucky, Institute for Mining and Minerals Research), Proceedings of the Second Kentucky Coal Refuse Disposal and Utilization Seminar, University of Kentucky, Institute for

D76-7 (continued)

Mining and Minerals Research, IMMR21-PD15-76 (1976). pp 21-35. Coal refuse samples from 23 of the largest coal preparation plants in Kentucky were evaluated for potential economic uses. Both current production samples and past production samples from refuse piles were evaluated. The sampling included wide geographical distribution and coal seam representation. Testing consisted of typical coal analyses, elemental analyses, and slow/quick firing tests. Results showed that some refuse will make satisfactory fired clay products. Another study showed that several samples from different mine locations could be used to make satisfactory aggregate for concrete. The use of "coal-crete" material as pillars in mined-out areas was proposed. Coal pillars left as roof supports could then be recovered. (From authors' abstract) CE200

D76-8 UTILIZATION OF COAL REFUSE AS A CONCRETE AGGREGATE (COAL-CRETE)

Bryenton, D. L. and Rose, J. G. (University of Kentucky), Proceedings of the Fifth Mineral Waste Utilization Symposium, Chicago, Illinois, by U.S. Bureau of Mines and IIT Research Institute, 1976. pp 107-113. In a laboratory study, coal refuse was utilized as aggregate for producing low-cost, low-quality concrete mixes which were evaluated as roof supports to replace coal pillars. The refuse came from three preparation plants operated by Island Creek Coal Company. Refuse characteristics were found to vary significantly from one location to another. High fines or clay content made poor concrete. Modifications of the refuse by washing or by adding natural river sand improved the concrete. 622 M6

D76-9 UTILIZATION OF COAL MINE REFUSE IN HIGHWAY EMBANKMENT CONSTRUCTION

Butler, P. E. (Pennsylvania Department of Transportation), AIME Annual Meeting, New York, New York, Feb. 16-20, 1975. Preprint No. 75F81. 32 pp. Also published in Transactions of AIME 260, 134-141 (1976). Since it was assumed that compacting refuse to its maximum density, i.e. to a minimum void ratio or air void percentage, would reduce the amount of oxygen available for spontaneous combustion or acid production, laboratory testing was carried out to determine refuse compaction characteristics. Refuse from the Harry E. breaker in Swoyerville, used in the Cross Valley Expressway, Luzerne County, Pennsylvania, was compared to refuse from the eastern bituminous coal field at Revloc, Cambria County, Pennsylvania. The Revloc refuse was planned to be used in another project. Methods of construction with refuse and the design and stability of embankment slopes are also discussed. AIME, Jour

D76-10 VEGETATING COLLIERY SPOIL

Chadwick, M. J. and Hardiman, K. M. (University of York, England), in "Papers of the Land Reclamation Conference Held at the Civic Hall, Grays, Essex, England," Oct. 5-7, 1976, J. Essex and P. Higgins, Eds., Grays, Essex, England: Thurrock Borough Council, 1976. pp 421-441. This study of plant succession and seed germination on refuse piles was carried out on refuse from five sources in Yorkshire. There was no correlation between pH and age of the

D76-10 (continued)

refuse pile, but there was correlation between number of plant species germinating on a refuse pile and the pH of that refuse. 631 T542

D76-11 HOW WASTE LIME IS HELPING TO TRANSFORM COLLIERY TIPS INTO PRODUCTIVE GRASSLAND

Charlesworth, D., British Sugar Beet Review 44 (2), 18-20 (1976). Sugar beet lime, a waste material high in calcium, and with significant amounts of phosphorus, magnesium, and nitrogen, has been used in Great Britain in the revegetation of coal refuse piles which usually have severe phosphate deficiencies. The complete razing of the Bullcroft Colliery near Doncaster in South Yorkshire and the restoration of the site to agriculture and woodlands are described. In addition to the plant nutrients, the sugar beet lime used at that site was shown to have about one half of the neutralization capacity of ground limestone. The use of sugar beet lime at other sites where its neutralizing capacity is advantageous is noted. CE351

D76-12 UTILIZATION OF SOLID WASTE OF THE COAL INDUSTRY

Chauvin, R. and Delannoy, G. (CERCHAR), Seventh International Coal Preparation Congress, A. C. Partridge, Ed., Sydney, Australia, by Australian National Committee, 1976. Paper L.1. 14 pp. In France, various uses of coal refuse as building and construction materials have been investigated. 662.6 I927

D76-13 INVESTIGATION AND STATISTICAL ANALYSIS OF THE GEOTECHNICAL PROPERTIES OF COAL MINE REFUSE

Chen, C. Y., University of Pittsburgh, Ph.D. Thesis, 1976. 196 pp. University Microfilms No. BNJ77-02993. Data collected from domestic and foreign sources were statistically analyzed to investigate degradation, strength characteristics, combustion potential, and permeability of coal waste. The major conclusions derived from the study are: (1) the degradation of coal refuse from construction compaction and its effect on shear strength cannot be ignored; (2) the fine fraction affects the drained strength of both coarse and fine refuse; (3) specific gravity or coal content also significantly affects the drained strength of fine refuse; (4) the influence of compaction on the reduction of air voids is quite significant and its effectiveness can be determined; (5) specific gravity can be used to estimate the maximum dry density determined by the Standard Proctor test and several other variables including the heating value of coal waste; and (6) permeability is affected by various parameters such as: void ratio, grain sizes, and fine fraction and can be estimated by two multiple regression equations established in this study respectively for coarse and fine refuse. A set of guidelines, based on the findings of the study, were formulated to ensure a proper utilization of coal refuse in engineering construction and to assist the mining industry in implementation of an economically and environmentally acceptable disposal method. (From author's abstract) 662.6 T41 F,CE327

D76-14 DEGRADATION AND THE RELATIONSHIP BETWEEN SHEAR STRENGTH AND VARIOUS INDEX PROPERTIES OF COAL REFUSE

Chen, C. Y. (1), Elnaggar, H. A. (2), and Bullen, A. G. R. (3) [(1) Michael Baker, Jr., Inc., (2) Orbital Engineering, and (3) University of Pittsburgh], Symposium on New Horizons in Construction Materials With Special Application to Geotechnical Engineering, Bethlehem, Pennsylvania, by Lehigh University, Nov. 1-3, 1976. (13 pp.) Previous studies have indicated that the mechanical breakdown during placement of the material is likely to have been the predominant cause of degradation and that the long term physico-chemical changes, after the refuse bank has been constructed, are only significant on the surface of the bank. This paper describes the extent of degradation caused by a given compactive effort and the effect of such degradation on shear strength of coarse refuse. This paper also presents established relationships between shear strength and various index properties such as the fine fraction and the specific gravity of both coarse and fine refuse. (From authors' abstract) CE416

D76-15 COAL REFUSE INSPECTION MANUAL

U.S. Department of Interior, Mining Enforcement and Safety Administration (MESA), April 1976. 121 pp. Available, Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402. Price $2.50. Stock No. 024-004-01879-8. This manual presents a system of classifying refuse disposal facilities as various types of non-impounding or impounding embankments. Photographs and diagrams are used liberally to illustrate conditions leading to or resulting from slope instability, and acceptable and unacceptable methods of handling refuse. Samples of completed inspection forms are given in the Appendix. 631 U58

D76-16 CYCLONE CLEANING OF FINE COAL REFUSE

Collins, J. W. and Draeger, E. A. (McNally Pittsburg Manufacturing Corporation), Proceedings of the Second Kentucky Coal Refuse Disposal and Utilization Seminar, University of Kentucky, Institute for Mining and Minerals Research, IMMR21-PD15-76 (1976). pp 97-102. The four types of cyclone cleaning described are: single stage hydrocyclone; two stage hydrocyclones; heavy media cyclone; and a combination of heavy media cyclone and hydrocyclone. Results of the four cleaning methods on feed from a Kentucky sludge pond, and from Pennsylvania and Virginia refuse piles, are tabulated. CE208

D76-17 A METHOD FOR MEASURING THE MINERALOGICAL VARIATION OF SPOILS FROM BRITISH COLLIERIES

Collins, R. J., Great Britain, Department of Environment, Building Research Station, Garston), Clay Minerals 11, 31-49 (1976). This study is a part of the work toward the use of unburnt coal refuse for the production of synthetic dense aggregates. Samples from eight collieries in Great Britain were compared by x-ray diffraction analysis. Results are tabulated and discussed

D76-17 (continued)

in detail. The most apparent difference is the high kaolinite and low illite content of the Scottish spoils and the high illite and low kaolinite content of the other six spoils. CE104

D76-18 AVAILABILITY OF MINING WASTES AND THEIR POTENTIAL FOR USE AS HIGHWAY MATERIAL: VOL. I. CLASSIFICATION AND TECHNICAL AND ENVIRONMENTAL ANALYSIS; VOL. II. LOCATION OF MINING AND METALLURGICAL WASTES AND MINING INDUSTRY TRENDS; VOL. III. ANNOTATED BIBLIOGRAPHY

Collins, Robert J., Valley Forge Laboratories, Inc., Report to U.S. Department of Transportation, Federal Highway Administration (May 1976). Vol. I, with Miller, R. H., Report No. FHWA-RD-76-106, 308 pp. Vol. II, Report No. FHWA-RD-76-107, 138 pp. Vol. III, Report No. FHWA-RD-76-108, 47 pp. Coal refuse is one of the mining wastes covered by these volumes. In the bibliography, 26 of the 80 references specifically relate to coal. 631 C71, CE285, CE286, CE287

D76-19 RECOVERY OF ALUMINA FROM COAL REFUSE AN ANNOTATED BIBLIOGRAPHY

Condry, L. Z., West Virginia University, Coal Research Bureau, Technical Report No. 130 (July 1976). 8 pp. Most of the 24 references are concerned with recovering alumina from fly ash. A few cover alumina extraction from refuse or from the ash from refuse. 662.6 W521

D76-20 CHOOSING CLOSED CIRCUITS FOR COAL PREPARATION PLANTS

Cooper, D. K. (U.S. Steel Corporation), Proceedings of the Second Kentucky Coal Refuse Disposal and Utilization Seminar, University of Kentucky, Institute for Mining and Minerals Research, IMMR21-PD15-76 (1976). pp 75-82. The paper describes the options explored to develop a closed water circuit for a preparation plant. The goal of the plans is to make feasible the production not only of recyclable water but also an easily handled and disposable product. A tabular comparison of the options shows that as the moisture of the dewatered solids is decreased, capital costs increase sharply. The option chosen uses vibrating drain screens and pressure filters. It produces a filter cake which can be mixed with coarse refuse for disposal without adversely affecting the structural integrity and stability of the refuse area. CE205

D76-21 UTILIZATION OF WASH WATER SLUDGE

Crossmore, E. Y. (Crossmore & Miller), National Coal Association/Bituminous Coal Research, Inc., Second Symposium on Coal Preparation Preprints, Louisville, Kentucky, 1976. pp 132-141. A process of making briquettes from coal preparation plant sludge is described in detail. The process steps include dewatering, deashing, and adding sodium chloride brine to act as a binder. Process economics are also presented. D468

D76-22 LIME HELPS ESTABLISH CROWNVETCH ON COAL-BREAKER REFUSE

Czapowskyj, M. M. and Sowa, E. A., U.S. Department of Agriculture, Northeastern Forest Experiment Station, Forest Service Research Paper NE-348 (1976). 6 pp. A study was begun in 1965 to determine the effect of lime, fertilizer, and mulch on the establishment and growth of crownvetch crowns planted on anthracite coal-breaker refuse. After 7 years the lime application had by far the strongest effect. Both 2.5 and 5.0 tons per acre increased survival and ground cover manyfold, and both treatments were equally beneficial from the first to the seventh growing season. The benefits of fertilizer and mulch were much less. Lime raised the pH to the neutral range, and this range was still the same 7 years after treatment. Exchangeable Ca and Mg were raised, and percentage of base saturation and cation exchange capacity increased significantly on areas that received lime and fertilizer treatments. (Authors' abstract) R1025

D76-23 ARBUSCULAR MYCORRHIZAS IN THE ANTHRACITE AND BITUMINOUS COAL WASTES OF PENNSYLVANIA

Daft, M. J. and Hacskaylo, E. (U.S. Department of Agriculture, Forest Service, Beltsville, Maryland), J. Applied Ecology 13 (2), 523-531 (1976). A study of one bituminous and two anthracite waste areas showed that the majority of plants on these areas were infected with endophytes. The leaf growth and yield of maize growing on sterile sand with bonemeal were increased by root washings from plants collected from one of the anthracite areas. Both inoculated maize and alfalfa grew in pH-adjusted anthracite waste but not in pH-adjusted bituminous waste. CE255

D76-24 BUILDING RESEARCH ESTABLISHMENT: SOME WORK IN PROGRESS: MINERALOGY OF COLLIERY SPOIL AND ITS UTILISATION

Dick, J. B., Gutt, W., and Collins, R. J., Chemistry and Industry, pp 339-341, April 17, 1976. The mineralogy of material from a number of refuse (spoil) piles in Great Britain has been investigated in order to correlate the differences between refuse materials with the differences between corresponding aggregates produced from these various refuse materials. A detailed study of refuse from one colliery showed that "the inherent variability of spoil is at least as great as the variation between collieries." CE589

D76-25 MODIFYING SLOPES TO IMPROVE EMBANKMENT STABILITY

Dmytriw, S. W. (1), Mazzei, D. (2), and Wu, K. K.-K. (2) [MESA, (1) Denver Technical Support Center and (2) Pittsburgh Technical Support Center], Proceedings of the Second Kentucky Coal Refuse Disposal and Utilization Seminar, University of Kentucky, Institute for Mining and Minerals Research, IMMR21-PD15-76 (1976). pp 37-46. Highlighted in this paper are the origin of coal refuse, an introduction to the mechanics of slope stability, general modes of failure, simplified methods of analysis, factors which affect stability and which are design considerations, and approaches which enhance stability. A significant portion of the article is written for the layman and is devoted to discussion and explanation of schematics which illustrate

D76-25 (continued)

remedial measures and design concepts which can increase factors of safety for a typical impounding structure. (From authors' abstract) CE201

D76-26 DEEP COAL MINING: WASTE DISPOSAL TECHNOLOGY

Doyle, W. S., Park Ridge, New Jersey: Noyes Data Corporation, 1976. 392 pp. The chapters on coal refuse in this book, "Extinguishing and Removing Burning Coal Refuse Banks," and "Sealing Coal Refuse Piles," are resumes of government reports on the subjects by Andreuzzi, by LaRosa, Karnavas, and Pelczarski, and by Tyco Laboratories, Inc. 622 D75d

D76-27 COAL REFUSE IN HIGHWAY EMBANKMENTS AND AGGREGATES

Drake, W. B. (Kentucky Department of Transportation), Proceedings of the Second Kentucky Coal Refuse Disposal and Utilization Seminar, University of Kentucky, Institute for Mining and Minerals Research, IMMR21-PD15-76 (1976). pp 17-19. The feasibility of coal refuse as a highway construction material is discussed generally. CE199

D76-28 HANDLING WASTE ROCK AT WARWICK MINE

Draper, J. C. (Duquesne Light Company), American Mining Congress Coal Show, Detroit, Michigan, May 10-13, 1976. Session Papers, Set No. 8. 6 pp. Removal of waste from the deep mine to the surface is by side-dump or granby-type cars. The cars' contents are dumped onto a conveyor which fills a truck which is driven to the rock disposal area. Scheduling and personnel responsibility for the operation are described. 662.6 A665

D76-29 FEASIBILITY STUDY OF UTILIZATION OF COAL MINE REFUSE, ESTILL COUNTY, KENTUCKY

University of Kentucky, Research Foundation, Report to Bluegrass Area Development District, under contract with Appalachian Regional Commission, Project ARC 74-217-Ky-3685 (Aug. 1976). (269 pp.) The report describes the sampling and extensive analysis and testing of refuse from Eastern Kentucky bituminous coal stored at the South-East Coal Company cleaning facility. Also covered in the report are studies of production of materials for use in the construction industry, market analysis for those materials feasible to produce, and a preliminary capitalization plan and flow sheet for lightweight aggregate production. (Adapted from Executive Summary) CE582

D76-30 EFFECTS OF MINING SUBSIDENCE ON COLLIERY SPOIL HEAPS: I, MINING SUBSIDENCE AND GEOTECHNICAL ASPECTS OF SPOIL HEAPS AND THEIR FOUNDATIONS; II, DEFORMATIONAL BEHAVIOR OF SPOIL HEAPS DURING UNDERMINING

Forrester, D. J. and Whittaker, B. N., International Journal of Rock Mechanics & Mining Sciences & Geomechanics Abstracts 13, I, 113-120; II, 121-133 (1976). In section I the theoretical concepts of mining subsidence are discussed and field methods of monitoring subsidence are described. Section II gives the

D76-30 (continued)

results of several field studies covering different conditions of refuse heaps and mining. These field observations show that refuse piles are influenced more by subsidence than was calculated by the National Coal Board Standard Subsidence Prediction. The refuse areas were also found to be influenced more by subsidence than were adjacent natural areas. CE103

D76-31 EXPERIENCE IN FIELD AND LABORATORY COMPACTION TESTING OF COARSE COAL MINE WASTE

Fredland, J. W., Jr. and Sawyer, S. G. (MESA, Pittsburgh, Technical Support Center), National Coal Association/Bituminous Coal Research, Inc., Second Symposium on Coal Preparation Preprints, Louisville, Kentucky, 1976. pp 160-174. Field densities have been measured at three refuse disposal sites in western Pennsylvania: two sites contain refuse from cleaning Pittsburgh coal, while the other site has refuse from the Thick Freeport coal seam. Additionally, material indexes have been determined and laboratory compaction tests have been conducted for the Thick Freeport coal refuse. This paper presents a summary of the findings of these completed field and laboratory tests. (From authors' Introduction) D471

D76-32 INVESTIGATION OF A SINTER PROCESS FOR EXTRACTION OF AL_2O_3 FROM COAL WASTES

Goodboy, K. P. (Alcoa Laboratories, East St. Louis, Illinois), in "Light Metals 1976. Vol. II. Alumina and Bauxite Production and Cast Shop Technology and Environmental Control," S. R. Leavitt, Ed., Proceedings 105th AIME Annual Meeting, Las Vegas, Nevada, 1976. pp 19-28. Coal cleaning-plant waste with high ash content was investigated as a possible source of soluble Al_2O_3 compounds. However, the presence of sulfur changed the chemical reactions in the conventional sinter process and resulted in compounds with slow, and therefore uneconomical, leaching rates. CE339

D76-33 INVESTIGATION OF A SINTER PROCESS FOR EXTRACTION OF AL_2O_3 FROM COAL WASTES

Goodboy, K. P. (Aluminum Company of America), Metallurgical Transactions B 7B (4), 716-718 (1976). Sulfur present in coal refuse results in different chemical reactions from those in the conventional lime sinter process. Coal waste sintered with limestone in an oxidizing atmosphere first forms calcium sulfate which then rapidly reacts to form calcium sulfoaluminate from which aluminuim oxide can be extracted in a short leach time. Although excess calcium sulfate can improve aluminum extraction somewhat, it can also react with the sodium carbonate leach to produce sodium sulfate which does not leach aluminum oxide from the sintered material. CE214

D76-34 DISPOSAL OF COAL MINING INDUSTRY BY-PRODUCTS

Grube, W. E., Jr., Harris, E. F., and Martin, J. F. (U.S. EPA, Cincinnati, Ohio), National Conference on Disposal of Residues and Land, St. Louis, Missouri, Sept. 13-15, 1976. 14 pp. This general review includes information

D76-34 (continued)

on elemental composition of coal in relation to washery wastes and mining refuse, as well as other coal mining and utilization waste products. The possibility for release of metallic elements from refuse disposal areas is discussed. CE112

D76-35 DENSE AGGREGATES

Gutt, W. H. and Russell, A. D. (to National Research Development Corporation), British Patent 1,453,641 (Oct. 27, 1976). 4 pp. According to this patent, dense aggregates are prepared from coal refuse by first crushing or grinding the refuse to at least a fineness of 1500 cm^2/g (as measured by the Lea-Nurse permeability method, British Standard No. 12, 1958), heating to remove free water and combustibles, further heating the material to sinter temperature, then comminuting the sintered material. The fineness of the material from the initial grinding is seen as critical for the production of material which can be classified as "dense" aggregate. Brit Pat

D76-36 LAND RECLAMATION IN STOKE-ON-TRENT. PAPER TWO: CIVIL ENGINEERING ASPECTS

Hampson, R. W. (City of Stoke-on-Trent, Environmental Services Department), Chartered Municipal Engineer 103 (10), 173-177 (Oct. 1976). Among the problems in reclaiming mining sites discussed by the author are burning refuse and settling ponds for disposal of refuse slurries. CE335

D76-37 CHEMICAL STABILIZATION OF FINE COAL REFUSE WITH CALCILOX® ADDITIVE STABILIZATION TECHNIQUES

Hoffman, D. C. and Snyder, G. A. (Dravo Lime Company), Proceedings of the Second Kentucky Coal Refuse Disposal and Utilization Seminar, University of Kentucky, Institute for Mining and Minerals Research, IMMR21-PD15-76 (1976). pp 83-88. The chemical stabilization of fine refuse by Calcilox is described, and the improved engineering properties of the stabilized refuse are shown. CE206

D76-38 GEOTECHNICAL ASPECTS OF COAL WASTE EMBANKMENTS

Holubec, I. (Geocon Ltd.), Canadian Geotechnical J. 13, 27-39 (1976). This paper is based on studies of West Virginia refuse banks and slurry impoundments and on a review of the North American, British, and German literature on coal waste. The geologic occurrence of coal seams and related strata is described to give an understanding of the components of coal refuse. The engineering properties of both coarse and fine refuse are discussed. The problems of coal refuse embankments result from physical and chemical weathering, spontaneous combustion, acid production, and embankment instability caused by water seepage and flow. CE159

D76-39 SOME GEOTECHNICAL PROPERTIES OF MINERAL WASTE TAILINGS LAGOONS

Hughes, J. M. and Windles, D. (Cambridge University), Ground Engineering 9 (1), 23-29 (1976). British studies of coal refuse lagoons and a lagoon used for disposal of china clay waste show that the fine and coarse materials which settle out differentially can have different properties depending on whether the materials are wet or dry, consolidated or unconsolidated. CE181

D76-40 THOSE WASTE BANKS COULD BE SOURCES FOR FUEL, ALUMINA

Kealy, D. (1), Backer, R. R. (1), Atkins, L. (1), and Busch, R. A. (2) [(1) U.S. Bureau of Mines, Spokane, Washington and (2) Gonzaga University], Coal Mining & Processing 13 (8), 46-49 (1976). This article reviews studies characterizing coal refuse carried out at the Spokane Mining Research Center. The information has been reported by the authors in RI 8062, "Physical property data on fine coal refuse," and an earlier publication RI 7964, "Physical property data on coal waste embankment materials." CE80

D76-41 FROST HEAVE AND HEAVING PRESSURE MEASUREMENTS IN COLLIERY SHALES

Kettle, R. J. (1) and Williams, R. I. T. (2) [(1) University of Aston in Birmingham and (2) University of Surrey, England], Canadian Geotechnical Journal 13 (2), 127-138 (May 1976). Laboratory tests were carried out on a number of refuse materials, both burnt and unburnt, and unbound and cement stabilized. Distinctive heaving pressures were found for each unbound material, with materials having higher amounts of fines developing higher pressures. Pressures developed by cement-stabilized materials were generally similar to those found for unbound materials, except that materials which were finer grained developed somewhat lower heaving pressure. CE409

D76-42 KOCHER COAL CO. CLOSES WATER CIRCUIT, ELIMINATES SETTLING-POND PROBLEMS

Coal Age 81 (8), 98-99 (Aug. 1976). This coal cleaning operation of Kocher Coal Co., in the anthracite region of Pennsylvania, includes a thickener and a vacuum filter for dealing with refuse slurry. Flocculant promotes settling of solids and maximum dryness of the refuse filter cake, which is disposed of as a solid in such a way that in the future it can be recycled to recover any remaining coal. Clear overflow from the thickener returns by gravity to the fresh-water reservoir. Water from the vacuum filter is returned to the thickener. Jour, CE669

D76-43 GOB AGGREGATE CONCRETE PRODUCTS

Lawrence, W. F. and Slonaker, J. F., West Virginia University, Coal Research Bureau, Report No. 120 (Feb. 1976). 13 pp. Coal preparation plant waste material was evaluated in test cylinders and it was found that good surface bonding of the aggregate particles was achieved. Mine stopping blocks prepared by a manufacturer and tested by a commercial testing laboratory showed satisfactory compressive strengths. Coal waste material made blocks that were superior to commercial blocks in simulated fire exposure tests. However, the experimental blocks were disintegrated by weathering. CE240

D76-44 LAND RECLAMATION IN STOKE-ON-TRENT. PAPER ONE: SETTING THE SCENE

Mackintosh, I. B., Chartered Municipal Engineer 103 (10), 165-172 (Oct. 1976). Derelict land in Stoke-on-Trent includes refuse piles from coal mining and coal cleaning as well as abandoned railway lines and worked out clay pits and areas of discards related to the pottery industry. The organization of the reclamation program, its costs, and achievements such as park land, land for industrial development, and a lake and recreation area, are described. An active refuse pile was designed to conform to projected reclamation plans. CE335

D76-45 ASSESSMENT OF LATEST TECHNOLOGY IN COAL REFUSE FIRE EXTINGUISHMENT

Maneval, D. R. (Appalachian Regional Commission), Mining Congress Journal 62 (5), 45-52 (1976). Also presented, American Mining Congress Coal Show, Detroit, Michigan, May 10-13, 1976. Session Papers, Set No. 9. 23 pp. A number of fire control techniques are discussed and include the use of water as sprays or as slurry injections, blanketing the fire area with incombustible material, and digging out the burning bank. The hazards associated with all these methods are pointed out. Methods of constructing refuse piles to minimize burning are described. Jour

D76-46 COAL REFUSE UTILIZATION PROSPECTS--AN UPDATE OF RECENT WORK

Maneval, D. R. (Appalachian Regional Commission), National Coal Association/Bituminous Coal Research, Inc., Second Symposium on Coal Preparation Preprints, Louisville, Kentucky, 1976. pp 184-198. Work reviewed includes highway projects in Pennsylvania, studies to evaluate coal refuse at the University of Kentucky, and a cooperative project to eliminate Bethlehem Mines Corporation's Revloc refuse pile in central Pennsylvania. D472

D76-47 HOW ARC HELPS LOCAL AREAS WITH ABANDONED MINE PROBLEMS - A COAL REFUSE FIRE EXAMPLE

Maneval, D. R. (Appalachian Regional Commission), Proceedings of the Second Kentucky Coal Refuse Disposal and Utilization Seminar, University of Kentucky, Institute for Mining and Minerals Research, IMMR21-PD15-76 (1976). pp 5-12. This paper discusses the general guidelines for ARC assistance in dealing with problems from abandoned mines. Causes of coal refuse bank fires and methods of preventing and extinguishing them are described. CE198

D76-48 THE IMPACT OF COAL REFUSE DISPOSAL ON WATER QUALITY

Martin, J. F. (U.S. EPA, Cincinnati, Ohio), in "Proceedings of the Third National Conference on Complete WateReuse: Symbiosis as a Means of Abatement for Multi-Media Pollution," Cincinnati, Ohio, by U.S. EPA Technology Transfer and American Institute of Chemical Engineers, June 27-30, 1976. pp 437-440. The investigations of EPA on the effects of coal refuse disposal on water are reviewed. 628.2 A512

D76-49 USE OF FLOCCULANTS AND COAGULANTS IN COAL REFUSE DEWATERING

McIntyre, G. F. and Mattix, R. D. (Nalco Chemical Company), Proceedings of the Second Kentucky Coal Refuse Disposal and Utilization Seminar, University of Kentucky, Institute for Mining and Minerals Research, IMMR21-PD15-76 (1976). pp 93-95. This paper discusses the theory and use of flocculants and coagulants for treating refuse slurries to produce solids that can be disposed of in landfills. CE207

D76-50 THERMAL DISPOSAL OF FINE REFUSE IN A FLUIDIZED BED

Metheny, D. E. (Heyl & Patterson, Inc.), National Coal Association/Bituminous Coal Research, Inc., Second Symposium on Coal Preparation Preprints, Louisville, Kentucky, 1976. pp 142-151. Slurries of fine refuse from two sources were fed to an 18 inch diameter refractory lined fluidized-bed pilot plant to gain experience with this method of sludge disposal. Chemical analyses of both the feed and the ash product are tabulated. Suspending the ash pellets from the pilot plant in water for extended periods resulted in only slightly increased pH of the water. D469

D76-51 MILLION-DOLLAR REFUSE DISPOSAL SYSTEM

Coal Mining & Processing 13 (12), 80-82 (1976). The refuse disposal system at Cannelton Industries' Maple Meadow Mining Company near Beckley, West Virginia, includes a specially prepared disposal site, belt conveyors, mine car haulage, a hard-surface haulage road, and an emergency disposal system. The system costs are tabulated. CE149

D76-52 METHOD OF TREATING COAL MINING REFUSE

Minnick, L. J., Webster, W. C., and Smith, C. L. (to IU Conversion Systems, Inc.), British Patent 1,436,507 (May 19, 1976). 6 pp. High-sulfur, acid-producing coal refuse is treated with lime and water and mixed with pozzolanic material to form a hard material. Among the uses claimed for the method are as an impermeable surface on coal refuse piles to prevent rain water percolation and as road base in highway construction. Brit Pat, CE653

D76-53 FINE COAL DRYING

Moore, P. L., Jr. (Dresser Industries, Inc., Jeffrey Manufacturing Division), Proceedings of the Second Kentucky Coal Refuse Disposal and Utilization Seminar, University of Kentucky, Institute for Mining and Minerals Research, IMMR21-PD15-76 (1976). pp 91-95. The fluidized-bed method described here for drying fine coal reclaimed from sludge ponds uses a modified mechanical vibrating conveyor. Hot air forced through the screen openings removes moisture and then ambient air forced into the system cools the coal. CE198a

D76-54 LONGWALL GOB DEGASIFICATION WITH SURFACE VENTILATION BOREHOLES ABOVE THE LOWER KITTANNING COALBED

Moore, T. D., Jr., Deul, M., and Kissell, F. N., U.S. Bureau of Mines, RI 8195 (1976). 13 pp. Methane emission from two surface gob-degasification

D76-54 (continued)

boreholes was measured by the Bureau of Mines. The investigation took place during mining of a 3,200-foot longwall panel in the Lower Kittanning coalbed in central Pennsylvania. The first hole was 500 feet from the start of mining, and the second hole was 2,200 feet. The first hole went on natural draft as soon as the longwall face passed it. This caused the methane flow in the return entries to drop 75 pct. In the 6 months required to complete the panel, the two holes emitted 69 MMcf of methane in varying percentages of concentration in air. In 3 years, the holes emitted a total of 150 MMcf of methane. (Authors' abstract) BurM

D76-55 COAL ASH AND COAL REFUSE: NEW POTENTIAL RESOURCES

Morrison, R. E. and Kinder, D. L. (American Electric Power Service Corporation), Proceedings of the Second Kentucky Coal Refuse Disposal and Utilization Seminar, University of Kentucky, Institute for Mining and Minerals Research, IMMR21-PD15-76 (1976). pp 69-73. This paper discusses the resource potential of the utilization of power plant ash and coal refuse. Examples are given to show how these coal by-products can be turned from a liability to an asset. (Authors' abstract) CE204

D76-56 THE USE OF COAL ASSOCIATED WASTES IN THE CONSTRUCTION AND STABILIZATION OF REFUSE LANDFILLS

Moulton, L. K. (1), Rao, S. K. (2), and Seals, R. K. (1) [(1) West Virginia University and (2) GAI Consultants], in "New Horizons for Construction Materials," Vol. 1, H. Y. Fang, Ed., Lehigh Valley, Pennsylvania: Envo Publishing Company, Inc., 1976. pp 53-65. The results of laboratory and field studies pertinent to the use of coal mine refuse and fly ash as cover materials for municipal-refuse landfills and results of those studies dealing with the stabilization of refuse landfills by injection of fly-ash grout are presented and discussed. Experiences with the use of bottom ash as road base and in landfill haul roads are cited. It is concluded that there are definite advantages to the use of coal-associated wastes as landfill cover, in haul roads, and in landfill stabilization, as long as the unique properties of these materials are recognized and controlled to minimize possible detrimental environmental impacts. (Adapted from authors' abstract) CE592

D76-57 COAL PREPARATION ENVIRONMENTAL ENGINEERING MANUAL

Nunenkamp, D. C., J. J. Davis Associates, Report to U.S. EPA, Industrial Environmental Research Laboratory, Research Triangle Park, North Carolina, EPA-600/2-76-138 (May 1976). 726 pp. NTIS, PB-262 716. The Manual covers the general nature and characteristics of U.S. coals, provides an overview of the coal preparation plant, discusses the major equipment and processes currently in use in coal preparation, identifies the primary waste streams found during the coal cleaning operation, discusses the techniques of control currently applied to those waste streams, and describes the contaminant removal potential of coal. (From author's abstract) 662.6 N97

D76-58 INDICATORS OF COAL REFUSE EMBANKMENT STABILITY

Parker, W. W. and Gray, R. E. (GAI Consultants, Inc.), Proceedings of the Fifth Mineral Waste Utilization Symposium, Chicago, Illinois, by U.S. Bureau of Mines and IIT Research Institute, 1976. pp 86-91. Characteristics which are easily seen and which may indicate the instability of refuse banks include cracks or irregularities in profile of crest or slope, erosion, seepage or piping (erosion of fine materials from the interior of the embankment), poor condition of hydraulic control facilities, steep slope angles, and the attitude of trees or tall vegetation on the slopes. With the help of these visual indicators, personnel from General Analytics, Inc., inspected 179 coal refuse disposal sites from 1972 to 1975. Construction and operation of refuse disposal areas were also observed and methods contributing to unstable conditions are discussed. 622 M6

D76-59 THE AVON COLLIERY AND WASHERY: ENVIRONMENT PROTECTION MEASURES

Pryor, A. G., Mine and Quarry Mechanisation, pp 128-129, 131, 133, 1976. Among the projects carried out to protect the environment at the Avon Colliery, New South Wales, Australia, was the design of the system to handle and store both fine and coarse coal refuse. Coarse refuse was used to form part of the basin used for coal stock piling and was also compacted into dams which impounded the fine refuse slurry and allowed it to drain naturally. Drainage was finally conducted to the silt trap dam where any remaining particles were removed. D247

D76-60 BURNT COLLIERY SHALE AS A PLANT GROWTH MEDIUM

Pulford, I. D. and Duncan, H. J. (Glasgow University), Surveyor 147 (4385), 27 (June 25, 1976). An advantage of burnt refuse is that it does not weather to produce acid. The plant availability of metals was greatest in refuse heated to about 450 C and decreased at higher temperatures, in some cases, even below levels found in unburnt refuse. Addition of organic material or fertilizer may be necessary for establishing vegetation on refuse. CE106

D76-61 KENTUCKY COAL REFUSE: A GEOCHEMICAL ASSESSMENT OF ITS POTENTIAL AS A METALS SOURCE

Robl, T. L., Bland, A. E., and Rose, J. G. (University of Kentucky, Institute for Mining and Minerals Research), National Coal Association/Bituminous Coal Research, Inc., Second Symposium on Coal Preparation Preprints, Louisville, Kentucky, 1976. pp 152-159. Coal refuse samples were taken from 23 of the largest coal preparation plants in Kentucky, located in both the eastern and western coal basins. Total sulfur, Btu, and ash contents were determined for the bulk material. Complete major and selected minor and trace elements analyses were performed on the ash fractions of the material. The refuse from the eastern coal field contained more aluminum oxide and titanium dioxide and less calcium oxide and ferric oxide in the ash and less bulk sulfur than the refuse from the western field. The Hazard No. 4 coal seam was found to produce a refuse with an aluminum oxide content of 33 to 38 percent; the range for the other eastern coal seams was 22 to 27 percent. The concentration of

D76-61 (continued)

zinc was found to be about three times greater in the western coal field than in the eastern. As much as 0.1 percent zinc was found in refuse from the No. 11 seam. (From authors' abstract) D470

D76-62 COMPOSITION AND PROPERTIES OF REFUSE FROM KENTUCKY COAL PREPARATION PLANTS

Rose, J. G., Robl, T. L., and Bland, A. E. (University of Kentucky), Proceedings of the Fifth Mineral Waste Utilization Symposium, Chicago, Illinois, by U.S. Bureau of Mines and IIT Research Institute, 1976. pp 123-131. Samples from 23 of the largest coal preparation plants in Kentucky represented a wide geographical area, a large number of coal seams, and both current and past production. Testing consisted of typical coal analyses, elemental analyses, and slow/quick firing tests. Results indicate that some of the refuse will make satisfactory fired clay products and some showed promise as expanded lightwight aggregate. Ash, Btu, and sulfur contents were found to vary over a wide range, reflecting different processing techniques and geological environments. Eastern Kentucky samples contained relatively high aluminum oxide and western Kentucky samples contained high ferric oxide, calcium oxide, phosphorus pentoxide, and sulfur. Characteristics were quite similar within a seam or between old and new refuse. Variations were significant from one seam to another. (Authors' abstract adapted) 622 M6, CE132

D76-63 FLY ASH GROUT SNUFFS STUBBORN COAL REFUSE FIRE

Ryan, C. R. (Engineered Construction International, Inc.), Electric Light and Power 54 (6), 27-28 (1976). A long-burning refuse pile near an Ohio Edison generating plant was extinguished by slurried fly ash injected through pipes driven into the burning zone. The method, developed by the Bureau of Mines before 1960, is described in detail. CE180

D76-64 REFUSE PILE FIRE ABATEMENT USING FLY ASH INJECTION

Ryan, C. R., Proceedings, Fourth International Ash Utilization Symposium, St. Louis, Missouri, by National Ash Association, Edison Electric Institute, American Public Power Association, National Coal Association, and Energy Research & Development Administration, March 24-25, 1976, J. H. Faber, A. W. Babcock, and J. D. Spencer, Eds., Energy Research and Development Administration, Morgantown Energy Research Center, MERC/SP-76/4 (undated). pp 665-676. NTIS, CONF-760322 In this method of burning-refuse control, fly ash slurry is injected into the burning-refuse area by means of pipes which also carry geothermal probes to monitor the extent of the burning and the success of extinguishing the fire. The use of the method in controlling a fire in Akron, Ohio, is described in detail. 628.5 U952

D76-65 MINE REFUSE IMPOUNDMENTS IN THE UNITED STATES

Schlick, D. P. (1) and Wahler, W. A. (2) [(1) U.S. Department of Interior, MESA and (2) W. A. Wahler & Associates], U.S. Department of Interior, Mining Enforcement and Safety Administration, IR 1028 (1976). 39 pp. This paper describes the development of various types of refuse embankments, including coal refuse, and surveys the factors influencing their effectiveness, efficiency, economy, safety, environmental suitability and proper use of resources. The present state-of-the-art in the United States and South America and the present programs for the development of improved technology and regulatory control are described. Waste material and structure types, and state or condition characteristics and classification systems are also presented. (From authors' abstract) D425

D76-66 MINE WASTE EMBANKMENTS NEED SAME ENGINEERING ATTENTION AS EARTHFILL DAMS

Singh, M. M., Coal Age 81 (5), 112-116 (1976). In this discussion of design to counteract characteristics causing instability in mine waste embankments and dams for settling ponds, the Aberfan and Buffalo Creek disasters are cited as examples of problems that can be encountered. Jour

D76-67 SUPPORT CAPABILITIES OF PNEUMATICALLY STOWED MATERIALS

Soderberg, R. L. and Corson, D. R., U.S. Bureau of Mines, RI 8202 (1976). 48 pp. Coal mine waste is one of several backfilling materials discussed and evaluated in this project. Coal refuse used at the test facility at Spokane Mining Research Center was obtained from the Palmer Coking Co., Black Diamond, Washington. Although the refuse was somewhat more difficult to handle than the other materials studied, the authors conclude that pneumatic stowing could be used to place refuse in abandoned mines in order to eliminate surface storage and impoundments. BurM, CE405

D76-68 RECLAMATION OF ANTHRACITE COAL REFUSE USING TREATED MUNICIPAL WASTEWATER AND SLUDGE

Sopper, W. E., Kardos, L. T., and DiLissio, L. E., The Pennsylvania State University, Institute for Research on Land and Water Resources, Research Publication 94 (Dec. 1976). 95 pp. The study was carried out in four boxes, 4 x 32 x 4 feet deep, filled with anthracite coal refuse from a mining operation in the northern anthracite coal field near Ashley, Pennsylvania. The boxes were equipped with lysimeters in order to sample refuse percolate. During the summer of 1973, nineteen weekly applications were made of sewage effluent in one box and of two levels of sludge plus effluent in the remaining two boxes. One box was used as control. The application of sludge appears to be necessary for successful establishment of a dense ground cover. Chemical analyses of the grasses revealed an increase in the content of nitrogen, phosphorus, and calcium with each increase in fertilizer value of treatment. The legumes showed no difference in concentration of macroelements as a result of the waste treatments. The suggested toxic levels of foliar aluminum and manganese were exceeded by many of the trees, grasses, and legumes, including several of the most productive species. Application of treated domestic

D76-68 (continued)

sewage increased the pH of the coal refuse at each level of treatment. The effect of the effluent and sludge on pH was greatest at the 6-inch depth. In the percolate analyses, nitrate nitrogen exceeded the U.S. Public Health Service limit of 10 milligrams per liter at the highest level of treatment. Because of high concentrations of ammoniacal nitrogen contained in the sludge, ammoniacal nitrogen in the percolate from both sludge and effluent treatments exceeded recommended limits for domestic water supplies. Although maximum orthophosphate phosphorus concentrations were found in the percolate of the highest levels of treatment, it was still 99.8 percent removed by the anthracite coal refuse. At the 6-inch depth, and at all levels of sludge and/or effluent application, the soil solution pH was raised above the critical level of 4.0. At the 42-inch depth, this value was exceeded only at the highest level of treatment. Percolate concentrations of iron and aluminum were relatively low. Maximum iron concentrations were obtained in the control percolate. Maximum aluminum concentrations were obtained in the highest level of treatment in percolate and appear directly related to the application of aluminum in the sludge. The mean concentrations of manganese in all treatment percolates exceeded the U.S. Public Health Service standard but were well below levels recorded in bituminous spoil percolate. (Adapted from authors' abstract) CE605

D76-69 RECLAMATION OF A BURNED ANTHRACITE REFUSE BANK WITH MUNICIPAL SLUDGE

Sopper, W. E., Kardos, L. T., and Edgerton, B. R. (The Pennsylvania State University), Compost Science 17 (2), 12-19 (1976). The study was carried out in Scranton, Pennsylvania, at the Cedar Avenue refuse bank which had been graded after a fire in the refuse and underlying mine was extinguished in the period from 1966-70. Three experimental plots, divided into four subplots each, were treated with 0, 18, 34, and 66 dry tons per acre of sewage sludge and planted with ten species of trees, five species of grasses, and five species of legumes. Generally, growth was best on the plots treated with 34 tons of sludge per acre; grasses were better suited than legumes to revegetating refuse; and hardwood species grew better than conifers, particularly where herbaceous cover was used with tree planting. CE178

D76-70 DEWATERING AND DENSIFICATION OF COAL WASTE BY DIRECT CURRENT--LABORATORY TESTS

Sprute, R. H. and Kelsh, D. J., U.S. Bureau of Mines, RI 8197 (1976). 68 pp. Laboratory tests were performed using thickened underflow (no flocculant added) from a northern Appalachian coal preparation plant. Solids in this slurry were very fine with 65 percent of the particles less than 0.1 mm in diameter. Two other types of sludge were tested briefly--thickener underflow from a southern Appalachian coal preparation plant with flocculant added, and sludge from an acid mine drainage treatment plant. The underflow responded well to the treatment, but response of the sludge from the acid mine drainage treatment plant was poor. (From authors' abstract) BurM, CE631

D76-71 INFLUENCE OF COAL WASTE DISPOSAL REGULATIONS

Stanin, S. A. (U.S. Mining Enforcement and Safety Administration), American Mining Congress Coal Show, Detroit, Michigan, May 10-13, 1976. Session Papers, Set No. 9. 8 pp. The reactions to coal waste disposal regulations by various groups are discussed. 662.6 A665

D76-72 SURFACE SUBSIDENCE CONTROL IN MINING REGIONS

Final Environmental Impact Statement, U.S. Bureau of Mines, FES 76-58 (Nov. 5, 1976). (163 pp.) The Bureau of Mine's ongoing program in backfilling abandoned mines to control subsidence is described in detail. Coal refuse is one of the materials which has been used to fill mine voids. 631 U29s

D76-73 SURVEY OF MINING REFUSE USES IN NORTHEASTERN PENNSYLVANIA

The Urban Services Group, Inc., Washington, D.C., Draft Final Report to The Economic Development Council of Northeastern Pennsylvania, Dec. 20, 1976. (50 pp.) The occurrence of anthracite refuse banks is summarized, and the information available concerning refuse bank ownership, refuse characterization, refuse uses, and environmental problems of refuse banks is reviewed. Surface mine reclamation in the anthracite region is also reviewed. Appendixes list companies which have received permits to recover coal from anthracite refuse and which are licensed to strip mine in the anthracite region. CE260

D76-74 SYNTHETIC PIPE MAKES HIGH MARKS WITH PEABODY COAL

Coal Mining & Processing 13 (8), 57 (1976). Peabody Coal Company's experience with high density polyethylene pipe in carrying slurry from several coal preparation plants to the various disposal areas is described. CE80b

D76-75 UGLY WASTE AREAS UNDERGO BEAUTY TREATMENT

The Consol News, p 12, Feb.-March 1976. In this news note, the reclamation of refuse disposal areas for waste from Consolidation Coal's Montour No. 4 and No. 10 Mines in Pennsylvania is described and shown in photographs. CE883

D76-76 PROSPECTIVE USES FOR COLLIERY WASTE

Waters, P. L., Mine and Quarry Mechanisation, pp 184-185, 1976. This article reviews work carried out in Australia on fluidized-bed combustion of refuse and use of the combustion products as aggregate and fillers and in construction of roads and embankments. D246

D76-77 DISPOSAL OF COAL PREPARATION WASTES: ENVIRONMENTAL CONSIDERATIONS

Wewerka, E. M., Williams, J. M., and Vanderborgh, N. E., Fourth National Conference on Energy and the Environment, Cincinnati, Ohio, Oct. 5-7, 1976. Los Alamos Scientific Laboratory, LA-UR-76-2198. 7 pp. The major environmental problems associated with refuse from coal preparation activities are waste bank instability, leachate seepage, and burning waste-heap

D76-77 (continued)

emissions. The seriousness of these problems and some control methods used to lessen their environmental impacts are described. CE728

D76-78 ASSESSMENT AND CONTROL OF ENVIRONMENTAL CONTAMINATION FROM TRACE ELEMENTS IN COAL PROCESSING WASTES

Wewerka, E. M., Williams, J. M., and Wanek, P. L. (Los Alamos Scientific Laboratory), in "Proceedings of National Conference on Health, Environmental Effects, and Control Technology of Energy Use," Washington, D.C., by U.S. EPA, Office of Energy, Minerals and Industry, Feb. 9-11, 1976. pp 226-229. The need for obtaining information on minerals and trace elements in coal refuse is discussed. The government-funded program for coal-refuse characterization is described. 712.201 76-1; 628 U58h, CE633

D76-79 ENVIRONMENTAL CONTAMINATION FROM TRACE ELEMENTS IN COAL PREPARATION WASTES: A LITERATURE REVIEW AND ASSESSMENT

Wewerka, E. M., Williams, J. M., Wanek, P. L., and Olsen, J. D., Los Alamos Scientific Laboratory, Interagency Energy-Environment Research and Development Program Report to U.S. EPA and U.S. Energy Research and Development Administration, EPA-600/7-76-007, ERDA LA-6600-MS (Aug. 1976). 61 pp. Information on the chemistry of trace elements in coal processing wastes has been collected and evaluated to assess the potential for environmental contamination from these wastes. Most of the growing body of knowledge concerning trace elements and minerals in raw coals can be applied directly to coal wastes. The consensus from analytical studies is that nearly every naturally occurring element is likely to be present in coal and coal refuse. Although large concentrations of trace elements are discarded in the washing refuse and significant amounts of elements such as Fe, Al, Mn, Co, Ni, and Zn can be found in the drainage from coal mineral wastes, in general, the fate of trace elements during coal preparation or weathering, leaching, and burning is not well understood. Further research is needed in order to make a comprehensive assessment of the potential for environmental contamination from trace elements in coal wastes. (Adapted from authors' abstract) EPA, CE632

D76-80 NITROGEN MINERALIZATION AND NITRIFICATION IN AMENDED COLLIERY SPOILS

Williams, P. J. and Cooper, J. E. (University of York, Great Britain), Journal of Applied Ecology 13 (2), 533-543 (1976). One neutral and two acid sites in South Yorkshire were treated with limestone, NPK fertilizer, and nitrogen-rich organic wastes. Low pH seemed to slow mineralization of nitrogen. Limed and neutral coal wastes, which had been amended with organic wastes two years previously, released little mineral nitrogen when incubated for forty days, probably because the nitrogen had been mineralized and lost well before the samples for the study were taken. Acid coal waste, treated similarly, released more mineral nitrogen, but less than unfertilized grassland soil. CE815

1977

D77-1 COAL REFUSE DISPOSAL

Akers, D. J., West Virginia Univesity, Coal Research Bureau, Report No. 137, 11 pp. Presented, 52nd Annual Meeting, West Virginia Academy of Science, Salem College, Salem, West Virginia, April 1-2, 1977. This paper discusses the important factors in site evaluation and refuse pile design and construction that must be considered for prevention of fires in refuse piles and for control of water pollution. Criteria for slurry impoundments are also discussed and impoundment design information required by MESA is listed. 662.6 W521 137

D77-2 DIRT ABSORBING HEADING AT WHITWICK COLLIERY

Ash, J. W., The Mining Engineer 136 (194), 591-598 (1977). This article describes a mining system which can extract coal from a thin seam and, in an integrated operation, dispose of the mining dirt in an adjacent area. CE357

D77-3 ATTACK ON THE PROBLEM OF COAL WASHERY WASTE

Queensland Government Mining J. 78 (909), 337-338 (July 1977). A pilot-plant-sized fluidized-bed combustion unit has been built near the Glenlee coal preparation plant near Camden, New South Wales, Australia. The plant is designed to study the processing of both coal refuse accumulated over decades of mining and the washery rejects expected from the preparation of coking coal for the expanding export market. The combustor can accept a feed containing up to 80 percent ash and slurries containing as much as 60 percent water. The possibility of using the combusted waste in construction materials is noted. CE609

D77-4 PHYSICAL PROPERTIES OF WESTERN COAL WASTE MATERIALS

Backer, R. R., Busch, R. A., and Atkins, L. A., U.S. Bureau of Mines, RI 8216 (1977). 29 pp. This study was carried out mainly at two sites, one in northeastern New Mexico and one in central Utah, where preparation operations were similar to practices in the eastern coal regions. Results of chemical and physical analyses of both coarse and fine refuse are tabulated. New concepts relating statistical shear strength data to liquefaction potential are presented. The data indicate that western coal sludge is coarser with higher permeabilities and shear strengths than eastern deposits. (Adapted from authors' Conclusions and abstract) BurM

D77-5 COARSE DISCARD FROM MINES

Bell, F. G. (the Polytechnic, Sheffield, England), Civil Engineering, pp 37-39, March 1977. The variations in geotechnical characteristics and compositions of refuse are discussed, and results of testing material at Yorkshire Main Colliery and at Brancepeth tip are tabulated. The effects of weathering and combustion are also described. CE341

D77-6 BENEFICIATION AND UTILISATION OF COLLIERY (WASHERY) TAILINGS

National Coal Board, London, Final Report, Research Project 6220-73/8/804, for Commission of the European Communities, EUR 5847 EN (1977). Published by the Directorate General, Scientific and Technical Information and Information Management. Available, Office of Official Publications of the European Communities, C. P. 1003, Luxembourg, Luxembourg The present work has demonstrated the practicability of burning tailings in a fluidised bed combustor to produce an easily disposable residue. The principle activity has been to design, build and operate a 1.5 m diameter combustor unit of a nominal 1 tonne/h throughput; this plant has been successfully commissioned and is expected to exceed the design throughput. A novel spray assembly for feeding the tailings has been devised and a number of design faults have been rectified in operation. Support studies were conducted on smaller combustors (0.3 m and 0.9 m square) to establish the effects of feed variables, alternative spray designs, the control of bed particle size and the insulating properties of bed ash. Preliminary designs for commercial schemes based on scale-up of the pilot plant have been prepared with the prime objective of providing cost estimates. The proposals show the possibility of increasing overall throughput by using the hot gases generated in the combustor to flash-dry additional slurry. (From Summary of the Report) CEC

D77-7 THE SINTERED LIGHTWEIGHT AGGREGATE INDUSTRY

Berger, T. R. (Lightweight Aggregate Producers Association), in "Proceedings Third Kentucky Coal Refuse Disposal and Utilization Seminar," Lexington, Kentucky, by University of Kentucky and Southeast Community College, May 11-12, 1977, J. G. Rose, Ed., Institute for Mining and Minerals Research, IMMR32-M4-77 (Dec. 1977). pp 55-58. Available, ORES Publications, College of Engineering, University of Kentucky, Lexington, Kentucky 40506. NTIS, PB-279 321/4WE. This historical review of the production and use of lightweight aggregates highlights the use of coal refuse as a material from which to manufacture aggregates, and describes marketing and the use of LELITE by the Lehigh Navigation Coal Company, Inc. The problems for aggregate producers in complying with pollution control regulations are also discussed. 631 K3

D77-8 EVALUATION OF INTERSEAM AND COAL CLEANING EFFECTS ON THE CHEMICAL VARIABILITY OF PAST AND PRESENT KENTUCKY COAL REFUSE

Bland, A. E., Robl, T. L., and Rose, J. G. (University of Kentucky), Transactions of AIME 262, 331-334 (Dec. 1977). Analyses of samples from twenty-three of the largest coal processing plants in Kentucky show the variability of preparation plant refuse both among coal seams worked and between past and present production. This paper reports on part of a four-year project, "Utilization of Kentucky Coal Mine and Classification Plant Wastes and Mine Overburden as Useful and Economic Building Materials." Size fraction, ash and sulfur contents, trace elements, and refuse as a potential source of alumina are discussed. Jour

D77-9 ECONOMIC EVALUATION OF COAL REFUSE DISPOSAL SYSTEMS

Brown, R. E. (1), Wilson, T. C. (2), and Thomasson, D. L. (1) [(1) Law Engineering Testing Company and (2) American Electric Power Service Corporation Fuel Supply], National Coal Association/Bituminous Coal Research, Inc., Third Symposium on Coal Preparation Preprints, Louisville, Kentucky, 1977. pp 141-151. Three refuse disposal methods are compared. In the first, fine refuse is mechanically dewatered at the preparation plant, dewatered fines are mixed with coarse refuse, and the combination transported to the refuse pile. In another method, sediment is removed from a slurry settling pond with drag line, transported with coarse refuse, and dumped into pits excavated in the disposal area. In the third method, fine refuse slurry is pumped behind a dam constructed simultaneously with coarse refuse. D473

D77-10 LARGE DIRECT SHEAR TESTS FOR COAL REFUSE

Brown, R. E. and Swanson, P. G. (Law Engineering Testing Company), in "Geotechnical Practice for Disposal of Solid Waste Materials," New York: American Society of Civil Engineers, 1977. pp 87-102. This paper describes a large, stress-controlled, direct shear machine; presents a test program which evaluated the performance of the machine; and provides shear strength parameters measured for representative samples of coarse coal refuse. (From authors' abstract) CE874

D77-11 RECOVERING FINE-SIZE COAL FROM ALABAMA SURFACE MINE WASHER WASTES USING THE HUMPHREYS SPIRAL

Browning, J. S., University of Alabama, Mineral Resources Institute and State Mine Experiment Station, MRI Technical Report Series, T.R. Number 2, 1977. 11 pp. Humphreys spiral tests of fine coal wastes from nine preparation plants of Alabama strip mining operations were conducted to determine the feasibility of recovering low ash and sulfur fuel meeting steam coal specifications. The ash in the samples ranged from 9 to 51 percent, and the total sulfur ranged from 0.45 to 2.39 percent. Continuous laboratory tests gave good recovery of the coal with excellent rejection of the ash and pyritic sulfur. Coal recoveries of 83.6 to 94.1 percent were achieved from the different samples. Ash content of the clean coal products fell within a range of 5 to 12.2 percent, with a total sulfur content of 0.62 and 1.10 percent. In quality, the products were comparable or superior to those now being shipped from the preparation plants. (From author's abstract) CE607

D77-12 COAL PREPARATION--1976

Burgess, C. (Bethlehem Mines Corp.), Mining Congress Journal 63 (2), 21-25 (Feb. 1977). Fine coal processing, its problems, and methods of dealing with them are discussed. Dewatering the fine refuse and refuse disposal generally are among the problems considered. Jour

D77-13 RECOVERY OF ALUMINA FROM FLY ASH BY HIGH-TEMPERATURE CHLORINATION

Burnet, G., Murtha, M. J., and Wijatno, H. (Iowa State University), in "Proceedings Third Kentucky Coal Refuse Disposal and Utilization Seminar,"

D77-13 (continued)

Lexington, Kentucky, by University of Kentucky and Southeast Community College, May 11-12, 1977, J. G. Rose, Ed., Institute for Mining and Minerals Research, IMMR32-M4-77 (Dec. 1977). pp 83-88. Available, ORES Publications, College of Engineering, University of Kentucky, Lexington, Kentucky 40506. NTIS, PB-279 321/4WE. The high temperature chlorination process for recovering alumina from the non-magnetic fraction of fly ash is described. 631 K3

D77-14 SINTERED COAL REFUSE AS A GROWING MEDIUM FOR PLANTS

Buxton, J. W., Knavel, D. E., and Yost, G. (University of Kentucky), in "Proceedings Third Kentucky Coal Refuse Disposal and Utilization Seminar," Lexington, Kentucky, by University of Kentucky and Southeast Community College, May 11-12, 1977, J. G. Rose, Ed., Institute for Mining and Minerals Research, IMMR32-M4-77 (Dec. 1977). pp 65-67. Available, ORES Publications, College of Engineering, University of Kentucky, Lexington, Kentucky 40506. NTIS, PB-279 321/4WE. Rooted chrysanthemum cuttings and tomato plants were grown in nine media consisting of three sizes of sintered coal refuse combined in various proportions with peat. Although plants produced in the experimental media were considered equal in quality to plants grown in standard media, tomato plants grown in the experimental media having twenty-five percent coal refuse achieved the greatest average weight. Chrysanthemums grown in 1/8 inch coal refuse had the largest average diameter of blossoms, generally weighed more and were taller than chrysanthemums grown in the other media. The author points out that these differences may be the result of a greater moisture capacity of the growing medium with the largest proportion of peat. Also, it appeared that the sintered refuse did not release toxic chemicals to the plants. 631 K3

D77-15 MICROBIAL ECOLOGY OF COAL MINE REFUSE

Cameron, R. E. and Miller, R. M. (Argonne National Laboratory), International Symposium on Microbial Ecology, Dunedin, New Zealand, Aug. 22-26, 1977. (61 pp.) NTIS, CONF-770862-1. Baseline microbial and ecological studies of samples obtained from two abandoned coal mine refuse sites in the State of Illinois indicate that the unfavorable nature of refuse materials can be a very limiting factor for survival and growth of organisms. Despite the "foothold" obtained by some microorganisms, especially acidophilic fungi and some acidotolerant algae, the refuse materials should be amended or ameliorated to raise the pH, provide needed nutrients, especially nitrogen, and provide biodegradable organic matter, both for physical and biological purposes. Tests for presence and/or activity of iron and sulfur oxidizing bacteria, except for three samples, were inclusive. (From authors' Concluding Remarks) DOE

D77-16 OVERVIEW OF MESA REGULATIONS FOR REFUSE PILES AND RETAINING DAMS

Cannon, W. C. (MESA, Barbourville, Kentucky), in "Proceedings Third Kentucky Coal Refuse Disposal and Utilization Seminar," Lexington, Kentucky, by University of Kentucky and Southeast Community College, May 11-12, 1977,

D77-16 (continued)

J. G. Rose, Ed., Institute for Mining and Minerals Research, IMMR32-M4-77 (Dec. 1977). pp 43-45. Available, ORES Publications, College of Engineering, University of Kentucky, Lexington, Kentucky 40506. NTIS, PB-279 321/4WE. The publication, "Engineering and Design Manual - Coal Refuse Disposal Facilities," is described and MESA's program of enforcing refuse disposal regulations is outlined. 631 K3

D77-17 AN ALTERNATE MEANS OF TRANSPORTING COAL OR WASTE ROCK

Carstens, M. R. (1) and Leva, D. W. (2) [(1) Georgia Institute of Technology and (2) Tubexpress Systems, Inc.], National Coal Association/Bituminous Coal Research, Inc., Third Symposium on Underground Mining Preprints, Louisville, Kentucky, 1977. pp 86-98. The system described uses large-diameter pneumatic capsule pipelines. D481

D77-18 METHOD AND APPARATUS FOR RECOVERING BY-PRODUCT SILT FINES FROM A SLURRY THEREOF

Cass, B. E., Coate, D. W., and Quigley, J. R. (to Carad, Inc.), U.S. Patent 4,003,717 (Jan. 18, 1977). 8 pp. In this method of fine coal recovery from coal refuse, the refuse slurry is passed through a rotary-driven impeller feed conveyor simultaneously with a hot gas such as air or superheated steam. The slurry can be agglomerated into a desired size and can be dried to a particular moisture level. US Pat, CE622

D77-19 FROM UK: DEEP-CONE THICKENERS

Chironis, N. P., Coal Age 82 (10), 126-129 (Oct. 1977). The deep-cone thickener unit designed by the Mining Research and Development Establishment of National Coal Board has successfully treated coal refuse washery reject, having low solids content, to produce both a thickened sludge, with paste-like consistency, and clarified water to be recirculated to the coal processing operation. Installations at Oakdale colliery, Mid-Glamorgan, Markham colliery, North Derbyshire area, and Silverdale Colliery, Newcastle under Lyme, are described. A main purpose of the design of the apparatus is to provide better compression of the high molecular weight flocculants used to settle the particles of coal and refuse in the process water. Problems related to addition and mixing of flocculants are also discussed. The thickened sludge has been mixed with larger size rejects for disposal on refuse piles. Studies have also been carried out on fluidized-bed combustion of the sludge. Jour

D77-20 DISPOSAL OF REJECTS AND CONTROLLING REJECTS FIRES

Choudhry, V. (TISCO, Jamadoba, India), J. Mines, Metals & Fuels 25 (4), 122-123 (April 1977). The causes and methods of control of fires in coal refuse piles are summarized. CE599

D77-21 A CLEANING PLANT VS. THE SKEPTICS

Coal Age 82 (8), 48-52 (Aug. 1977). The cleaning plant operation, including disposal of refuse into an abandoned surface-mined area, is described. Jour

D77-22 AVAILABILITY OF MINING WASTES AND THEIR POTENTIAL FOR USE AS HIGHWAY MATERIAL - EXECUTIVE SUMMARY

Collins, Robert J. and Miller, R. H., Valley Forge Laboratories, Inc., Report to U.S. Department of Transportation, Federal Highway Administration, FHWA-RD-78-28 (Sept. 1977). 40 pp. NTIS, PB-287 511/OWP Coal refuse is one of the mining wastes covered by this project. This volume summarizes work reported in three volumes which are annotated at D76-18. 631 C71, CE285a

D77-23 COLLIERY SHALE-USEFUL IN FORMATION

Colman, R. B., Civil Engineering, pp 66-67, July/Aug. 1977. In reclaiming the site of the abandoned Swanwick colliery in Derbyshire, England, the unburnt refuse was used as fill after being tested and found to be an "easily compactable material with only limited inherent problems of swelling and spontaneous combustion." CE586

D77-24 CONSTRUCTION GUIDELINES FOR POLLUTION CONTROL FROM COAL REFUSE PILES AND SLURRY PONDS

Connell, J. P. (W. A. Wahler & Associates), National Coal Association/Bituminous Coal Research, Inc., Third Symposium on Coal Preparation Preprints, Louisville, Kentucky, 1977. pp 164-167. In carrying out the project to develop guidelines, eight active refuse piles and six slurry ponds were studied. Construction guidelines for refuse pile pollution control include layering and compaction, methods of drainage control, and preparing completed disposal areas for establishment of vegetation. Guidelines for slurry pond operation include recycling water where possible, or treating before returning to ground or surface waters, maximizing retention time to allow settling of solids, discharging slurry into the pond at a minimum velocity, and removing clear water from near the top of the pond. D475

D77-25 GEOTECHNICAL CHARACTERISTICS OF COAL MINE WASTE

Cowherd, D. C. (Bowser-Morner Testing Laboratories, Inc.), Proceedings of the Conference on Geotechnical Practice for Disposal of Solid Waste Material, American Society of Chemical Engineers, University of Michigan, Ann Arbor, Michigan, June 13-15, 1977. pp 384-406. This paper describes the design of two methods of coal refuse disposal as well as of the disposal of surface-mine overburden in a valley-fill operation. The first refuse disposal method described uses upstream construction in which a small embankment of coarse refuse is built and used to contain deposited slurry. The next embankment is built upon the first and stepped back over the previously deposited slurry, making a containment area for more slurry to be deposited. The process continues until the upstream area is filled. Studies were made of the stability of such a disposal area in southwestern Pennsylvania. In the second

D77-25 (continued)

refuse disposal method, coarse and fine refuse were combined and deposited as a single material. This material was deposited in a valley-fill configuration, with the assumption that it was to be a "dry" fill and impound no water. CE590

D77-26 COAL PREPARATION FOR GASIFICATION

Davis, H., Coal Age 82 (5), 79-82 (May 1977). At the Tuscarora Coal Corp., Schuylkill County, Pennsylvania, coal recovered from refuse banks in the anthracite region is combined with strip-mined anthracite coal from Gale Coal Company as feed to Wellman-Galusha gas producers. The low-Btu gas from the producers, owned by Glen Gary Corp., Reading, Pennsylvania, is being used as primary fuel for their brick kilns. A flow sheet illustrates Tuscarora's preparation plant and refuse handling. Jour

D77-27 MONTEREY NO. 2 BUILDS TOWARD ITS TONNAGE GOAL

Davis, H., Coal Age 82 (12), 96-100 (Dec. 1977). Included in this overview of the new surface facilities at the Illinois mine is a flow-sheet of the twin 1,000-tph coal cleaning circuits. The cleaning refuse is transported on conveyor belts to a bin, and is then hauled to a coal refuse disposal area where it is dumped, spread and compacted. Water is retained within the disposal area by a dike. A nearby holding pond collects water from the refuse runoff, and returns clarified water for recirculation. Jour

D77-28 ELECTRICITY SOLIDIFIES SLIME MINE WASTE

Coal Age 82 (3), 109 (1977). The electrolytic process which is described has been used successfully by the Bureau of Mines Spokane Mining Research Center on slimes from metal mining, and has shown promise in use with coal fines. Jour

D77-29 PRESSURE FILTRATION TECHNOLOGY IN THE COAL INDUSTRY

Forster, H. W. (Passavant Corp.), in "Proceedings Third Kentucky Coal Refuse Disposal and Utilization Seminar," Lexington, Kentucky, by University of Kentucky and Southeast Community College, May 11-12, 1977, J. G. Rose, Ed., Institute for Mining and Minerals Research, IMMR32-M4-77 (Dec. 1977). pp 15-18. Available, ORES Publications, College of Engineering, University of Kentucky, Lexington, Kentucky 40506. NTIS, PB-279 321/4WE. The application of the pressure filter in dewatering refuse and producing a low suspended solids filtrate is described. 631 K3

D77-30 PROCESSING PLANT FOR THE RECLAMATION OF COAL

Gay, L. T. and Batchelder, S., Mrs. (Coal Purification Associates of Kentucky, Inc.), in "Proceedings Third Kentucky Coal Refuse Disposal and Utilization Seminar," Lexington, Kentucky, by University of Kentucky and Southeast Community College, May 11-12, 1977, J. G. Rose, Ed., Institute for Mining and Minerals Research, IMMR32-M4-77 (Dec. 1977). pp 41-42. Available, ORES

D77-30 (continued)

Publications, College of Engineering, University of Kentucky, Lexington, Kentucky 40506. NTIS, PB-279 321/4WE. The use of the CPA Cyclone, a patented hydrocyclone for recovering coal from refuse, is described. Coal product includes both fines and larger sizes and, it is claimed, is shown by analysis to be similar to the coal originally mined at the site. 631 K3

D77-31 ENTERPRISE DEVELOPMENT: A FINANCIAL RESOURCE AND THE KENTUCKY ARC PROGRAM

Gilliam, D. R. (Appalachian Regional Commission), in "Proceedings Third Kentucky Coal Refuse Disposal and Utilization Seminar," Lexington, Kentucky, by University of Kentucky and Southeast Community College, May 11-12, 1977, J. G. Rose, Ed., Institute for Mining and Minerals Research, IMMR32-M4-77 (Dec. 1977). pp 69-70. Available, ORES Publications, College of Engineering, University of Kentucky, Lexington, Kentucky 40506. NTIS, PB-279 321/4WE. The participation of Kentucky in the development activities of the Appalachian Regional Commission is described. 631 K3

D77-32 FEATURES OF THE CHANGE IN THE PHYSICOCHEMICAL PROPERTIES OF COAL ENRICHMENT WASTES IN PROCESSES CONVERTING THEM INTO BUILDING MATERIAL

Glushnev, S. V., Demidov, L. G., Zharov, Yu. N., Zekel, L. A., Itkin, Yu. V., and Cherkinskaya, K. T., Solid Fuel Chemistry (Khimiya Tverdogo Topliva) 11 (4), 144-145 (1977). The Institute of Combustible Materials has studied the main changes in the physical and chemical properties of coal refuse from various coal basins in the USSR during the thermal processing of the refuse into building materials. The findings are summarized in this article. Jour

D77-33 POLLUTION CONCENTRATIONS IN RUNOFF WATER FROM REFUSE PILES

Guin, J. A., Auburn University, Water Resources Research Institute, Completion Report for OWRT Project DI-B-056-ALA, WRRI BULLETIN 26 (March 1977). 39 pp. A mass transfer model is formulated which describes the acidity, alkalinity, hardness, heavy metals and organic materials in leachates from refuse piles. Certain parameters appearing in the model are studied experimentally using an idealized refuse pile constructed of a difficultly soluble solid. Correlations for mass transfer coefficients in trickling flow and in nonuniform mixtures are developed from these experiments. Finally, the model is applied to an actual refuse pile under natural precipitation and weathering conditions and found to adequately represent the pollutant concentrations in the rainfall runoff. (From author's abstract) CE598

D77-34 USE OF COAL WASTES REINFORCED WITH ORGANIC BINDERS FOR ROAD BUILDING

Guryachkov, I. L., Glushnev, S. V., Borycheva, E. A., and Ignatova, N. N., Solid Fuel Chemistry (Khimiya Tverdogo Topliva) 11 (4), 147 (1977). In studies of coal refuse from the "Komendantskaya" TsOF [Central Enrichment Factory] (Donets Basin), it was found that the addition of lime or calcium chloride was needed for a satisfactory product when the refuse was used in cement. Jour

D77-35 LIGHTWEIGHT AGGREGATE AS A CONSTRUCTION MATERIAL

Hammond, J. D. (Georgia Lightweight Aggregate Co.), in "Proceedings Third Kentucky Coal Refuse Disposal and Utilization Seminar," Lexington, Kentucky, by University of Kentucky and Southeast Community College, May 11-12, 1977, J. G. Rose, Ed., Institute for Mining and Minerals Research, IMMR32-M4-77 (Dec. 1977). pp 51-53. Available, ORES Publications, College of Engineering, University of Kentucky, Lexington, Kentucky 40506. NTIS, PB-279 321/4WE. The production and use of lightweight aggregates are described in detail. 631 K3

D77-36 DAMS AND MINE WASTE STRUCTURES, AN EXAMINATION OUTLINE

Harner, R. E. (Travelers Insurance Company), Professional Safety 22 (1), 20-24 (1977). Different types of structures, their design and construction, and conditions indicating possible failure are described. A Glossary concludes the article. CE296

D77-37 SUMMER SOIL TEMPERATURE AS A FACTOR IN REVEGETATION OF COAL MINE WASTE

Harrison, J. E., in Geological Survey of Canada, Report of Activities Part A, Paper 77-1A (1977). pp 329-332. Available, Geological Survey of Canada, 601 Booth Street, Ottawa, K1A 0E8. $7.20 outside of Canada. During field studies in the Crowsnest Pass area of Alberta and British Columbia to investigate some geological engineering problems associated with reclamation of coal mine waste dumps, a number of observations indicated that high summer soil temperatures are an important factor in revegetation. This note reports on: a) the composition of the coal waste investigated; b) the variation of surface temperature with time, aspect, slope elevation, and depth; c) moisture conditions; d) thermal properties; and e) the implication of the data with respect to revegetation. (From author's abstract) 550 C212, CE620

D77-38 PUMP-PACKING SYSTEMS AT FLORENCE COLLIERY

Hodgkinson, D. R. (National Coal Board, Western Area), The Mining Engineer 136 (195), 707-716 (Aug./Sept. 1977). Pump-packing systems for use in conjunction with longwall mining are described and diagrams are presented. In the method, run-of-mine product, screened to 3/4 inch, is mixed with a flow agent and water. The resulting slurry is pumped to the area to be packed. There grout is added before the final pumped placement of the material. One conclusion is that a system could be developed which would use "ripping dirt" or coal mining refuse. The author also notes that this operation "is capable of keeping pace with modern advancing or retreating faces." Jour

D77-39 A COMPOSITE MATERIAL

Hodgkinson, N., Pritchard, F. W., and Lewis, S. [to Coal Industry (Patents) Ltd.], British Patent 1,473,517 (May 11, 1977). 3 pp. The patent describes the use of coal cleaning refuse as lightweight aggregate in making blocks to be used as packing in excavated areas for roof control. Brit Pat, CE623

D77-40   ALUMINUM FROM COAL WASTES?

Hudson, L. K. (Alcoa Technical Center), in "Proceedings Third Kentucky Coal Refuse Disposal and Utilization Seminar," Lexington, Kentucky, by University of Kentucky and Southeast Community College, May 11-12, 1977, J. G. Rose, Ed., Institute for Mining and Minerals Research, IMMR32-M4-77 (Dec. 1977). pp 79-82. Available, ORES Publications, College of Engineering, University of Kentucky, Lexington, Kentucky 40506. NTIS, PB-279 321/4WE. The current commercial method of aluminum production from bauxite is described and compared technically and economically to an acid process for extracting aluminum from clay or clay-like minerals, similar to the alumina-bearing fraction in coal refuse, and to processes involving sintering. The costs of the alternative processes for producing aluminum are shown to be so costly that they cannot compete with production from bauxite. 631 K3

D77-41   DISPOSAL OF COAL REFUSE SLURRY UNDERGROUND

Jankousky, C. K. (Freeman United Coal Mining Company), American Mining Congress, Coal Convention, Pittsburgh, Pennsylvania, May 1-4, 1977. Session Papers, Set No. 4, 11 pp. Also published in Mining Congress Journal 63 (9), 68-71 (1977). Several years' experience in pumping slurry from the coal preparation plant into an abandoned section of the Illinois Company's Orient #4 mine is described. Both slurry injection and water recovery boreholes were drilled. Recovered water returns to the lake that is the source of water for the preparation plant. Average values for various parameters of water quality are listed and the author notes that recycling is adding to the corrosiveness of the water supply. Other disadvantages of underground disposal are the possiblity of methane traveling back through the pipeline to the pump when the pump is off; and the inconvenience of carrying out maintenance on submersible pumps. The cost of disposing all refuse underground at this mine was estimated to be greater than the cost of surface disposal in areas enclosed in earthfill dams. 662.6 A665, Jour, CE323

D77-42   THE POTENTIAL ECONOMICS OF THE RECOVERY OF TRACE ELEMENTS IN COAL REFUSE

Katell, S. (West Virginia University), in "Proceedings Third Kentucky Coal Refuse Disposal and Utilization Seminar," Lexington, Kentucky, by University of Kentucky and Southeast Community College, May 11-12, 1977, J. G. Rose, Ed., Institute for Mining and Minerals Research, IMMR32-M4-77 (Dec. 1977). pp 89-95. Available, ORES Publications, College of Engineering, University of Kentucky, Lexington, Kentucky 40506. NTIS, PB-279 321/4WE. Also published as West Virginia University, Coal Research Bureau Technical Report No. 142 (undated). 10 pp. A detailed cost analysis of what is considered to be a typical system for extracting alumina from coal refuse is presented. 631 K3

D77-43   DEWATERING TAILINGS AND COAL FINES BY CENTRIFUGATION

Keith, F. W., Jr., Moll, R. T., and O'Donnell, C. (Pennwalt Corporation, Sharples-Stokes Division), National Coal Association/Bituminous Coal Research, Inc., Fourth Symposium on Coal Utilization Preprints, Louisville, Kentucky, 1977. pp 137-145. Dewatering refuse and fine coal by use of a solid-bowl

D77-43 (continued)

horizontal-conveyor type of centrifuge is described. Because more abrasive-resistant materials are now available, higher centrifugal force can now be used and dewatering will be improved. Performance data are given for western refuse and for three eastern refuse materials, at various feed rates and with and without polymer addition. D482

D77-44 GOB PILE AND SLURRY POND SEDIMENT BENEFICIATION USING THE OTISCA PROCESS

Keller, D. V., Jr. (Otisca Industries, Ltd.), in "Proceedings Third Kentucky Coal Refuse Disposal and Utilization Seminar," Lexington, Kentucky, by University of Kentucky and Southeast Community College, May 11-12, 1977, J. G. Rose, Ed., Institute for Mining and Minerals Research, IMMR32-M4-77 (Dec. 1977). pp 23-28. Available, ORES Publications, College of Engineering, University of Kentucky, Lexington, Kentucky 40506. NTIS, PB-279 321/4WE. A discussion of the definition of coal gob and slurry pond sediment based on coal market price, washability and coal preparation costs indicates the desirability for lower preparation costs of finer coals. One solution to this problem is the Otisca Process which is discussed in detail relative to slack coal and slurry pond coal beneficiation. (Author's abstract) 631 K3

D77-45 MINING

Kempster, E. [to Thyssen (Great Britain) Limited], U.S. Patent 4,019,327 (April 26, 1977). 5 pp. In a mine, pit dirt, after crushing if necessary, is mixed with bentonite and water to produce a sludge which is non-settling. The sludge is pumped through a pipe line to a point of utilization where it is fed into shuttering together with a setting agent to form a low quality concrete; this is used, for example, as a roof support in worked-out areas of the mine. The setting agent is preferably a mixture of cement and a water polyethylene oxide gel giving vary rapid setting. (Abstract of the disclosure) US Pat, CE366

D77-46 STATE-OF-THE-ART OF COAL CLEANING AND RECENT DEVELOPMENTS IN EQUIPMENT AND CIRCUITS

Killmeyer, R. P., Jr. (U.S. Bureau of Mines, Pittsburgh, Pennsylvania), in "Proceedings Third Kentucky Coal Refuse Disposal and Utilization Seminar," Lexington, Kentucky, by University of Kentucky and Southeast Community College, May 11-12, 1977, J. G. Rose, Ed., Institute for Mining and Minerals Research, IMMR32-M4-77 (Dec. 1977). pp 1-4. Available, ORES Publications, College of Engineering, University of Kentucky, Lexington, Kentucky 40506. NTIS, PB-279 321/4WE. Both the Lamella Thickener and the Enviro-Clear Thickener, used in dewatering coal preparation plant refuse, are described in this paper. 631 K3

D77-47 A METHOD OF INCINERATING SEWAGE SLUDGES

Kirkup, W. M. (to Esmil-Envirotech Limited), British Patent 1,465,869 (March 2, 1977). 3 pp. Coal fines, either as coal filter cake or as coal cleaning

D77-47 (continued)

slurry usually disposed of in lagoons, are used as fuel in this method of incinerating sewage sludges. Brit Pat

D77-48 THE POSSIBILITY OF OBTAINING NITRIDE-CONTAINING MATERIALS FROM COAL WASTES

Kost, L. A., Novikova, N. N., Sin'kova, L. A., and Shpirt, M. Ya., Solid Fuel Chemistry (Khimiya Tverdogo Topliva) 11 (5), 27-29 (1977). Methods of producing nitride-containing refractory material suitable for use under extremely severe conditions are summarized. The use of coal refuse as a raw material in the process is shown. Jour

D77-49 IMPACT OF GOB AND POWER-PLANT ASH DISPOSAL ON GROUND WATER QUALITY AND ITS CONTROL

Libicki, J. (Central Research and Design Institute for Opencast Mining, Poland), National Coal Association/Bituminous Coal Research, Inc., Third Symposium on Coal Preparation Preprints, Louisville, Kentucky, 1977. pp 185-204. Two sites for disposal of coal mining and preparation wastes and of coal ashes and slag from power plants were monitored. Increases in the content of a number of ions in the ground water are reported. Recommendations are made for classification of disposal areas, for testing refuse materials, and for monitoring ground water in order to protect aquifers from pollution. D476

D77-50 PROCESSING OF COAL REFUSE FOR A SECOND YIELD OF STEAM COAL

Maneval, D. R. (Appalachian Regional Commission), in "Proceedings Third Kentucky Coal Refuse Disposal and Utilization Seminar," Lexington, Kentucky, by University of Kentucky and Southeast Community College, May 11-12, 1977, J. G. Rose, Ed., Institute for Mining and Minerals Research, IMMR32-M4-77 (Dec. 1977). pp 31-39. Available, ORES Publications, College of Engineering, University of Kentucky, Lexington, Kentucky 40506. NTIS, PB-279 321/4WE. The author discusses the advantages of recovering coal from refuse sites and describes a number of coal recovery operations in the United States, especially in Pennsylvania, and in Europe. 631 K3

D77-51 RECENT DEVELOPMENTS IN REPROCESSING OF REFUSE FOR A SECOND YIELD OF COAL

Maneval, D. R. (Appalachian Regional Commission), National Coal Association/Bituminous Coal Research, Inc., Third Symposium on Coal Preparation Preprints, Louisville, Kentucky, 1977. pp 152-162. The author reviews seventeen projects for the reclamation of coal from refuse. The operations were carried out both in the United States, particularly Pennsylvania, and in Europe. D474

D77-52 MECHANISED PACKING FOR LONGWALL FACES

Mine and Quarry 6 (12), 12, 14-15, 17-18 (1977). The packing of the gateside both with refuse from the mining operation and with materials brought into the mine is discussed. Jour

D77-53 ANTHRACITE REFUSE IN ID-2A BITUMINOUS CONCRETE

Mellott, D. B., Pennsylvania Department of Transportation, Bureau of Materials, Testing and Research, Research Project No. 70-8, Final Report, March 1977. 7 pp. The results of four experimental projects and one control section placed in 1970 to evaluate the use of burned anthracite refuse as aggregate in asphaltic road surface materials are reported. Inspections were carried out over several years to assess wear and skid resistance of the experimental surfaces. The wear, which was more rapid than normal, was considered as contributing to the desired characteristic of good skid resistance. CE401a

D77-54 DERELICT SITE REJUVENATED FOR INDUSTRY

Millbank, P., Surveyor 149 (4419), 15 (Feb. 18, 1977). This article describes the development of an industrial park on a site in Newcastle-under-Lyme, formerly derelict land, which had included a large refuse pile. CE387

D77-55 STATIC BIOASSAY TESTING OF IOWA COAL BENEFICATION PLANT MAGNETITE-SLURRY WITH CHANNEL CATFISH (ICTALURUS PUNCTATUS)

Muncy, R. J. and Barrett, F. I., Iowa State University, Energy and Minerals Resources Research Institute, IS-ICP-60 (1977). 66 pp. In 1977, static bioassay tests were conducted under controlled laboratory conditions with coal waste water and reconstituted water containing crushed ISU coal, using channel catfish, *Ictalurus punctatus*, as test species at temperature of 22°C for 96 hours. Bioassay tests performed on February 15 and March 9 using coal waste water and on April 11 and April 22 using reconstituted water with crushed coal resulted in 100% mortality in the 60%, 100%, filtered (100%) concentrations and in the 200 mg coal/l, 20 mg coal/l and 7.2 mg coal/l concentrations at pH below 5.0. No mortality occurred in the lower concentrations or on any other tests. No large amounts of metallic ions were found in any of the samples analyzed which could attribute to the mortality observed. Increased concentration levels of coal waste water or crushed coal added to reconstituted water appeared to increase mortality by acting upon dissolved oxygen and/or pH. Higher concentration levels usually reduced survival time in those tests which mortalities occurred. Test solutions in which pH were lowered below 5.0 by adding sulfuric acid resulted in mortalities at higher concentrations of added crushed coal. (From authors' abstract) CE89b

D77-56 ILLINOIS LANDS AFFECTED BY UNDERGROUND MINING FOR COAL

Nawrot, J. R., Haynes, R. J., Pursell, P. L., D'Antuono, J. R., Sullivan, R. L., and Klimstra, W. D., Southern Illinois University, Cooperative Wildlife Research Laboratory, Report to Illinois Institute for Environmental Quality, March 1977. 195 pp. Both abandoned and active mines were inventoried and the

D77-56 (continued)

findings are summarized. Refuse piles and slurry impoundments and drainage from these areas are included in mining conditions identified as affecting land. Descriptions of the refuse areas include the types and amounts of vegetation growing on them. CE302

D77-57 PROBLEM SITES: LANDS AFFECTED BY UNDERGROUND MINING FOR COAL IN ILLINOIS

Nawrot, J. R., Pursell, P. L., Klimstra, W. D., and Jacobson, B. N., Southern Illinois University, Cooperative Wildlife Research Laboratory, Report to Illinois Institute for Environmental Quality, IIEQ Document No. 77/38 (Dec. 1977). 556 pp. Approximately 5,000 acres representing 508 mine sites located in 50 counties in Illinois are identified as problem areas having one or more of the following conditions: 1) exposed refuse materials, both gob and slurry, 2) abandoned tipple areas, 3) polluted water impoundments, 4) adjacent affected terrestrial areas, 5) mine drainage to adjacent ditches, streams, and/or rivers, and 6) potentially hazardous mine openings including openings with mine drainage. In addition to physical and vegetational descriptions, analyses of refuse samples as well as drainage samples are included with individual mine site descriptions. An objective ranking system of problem sites based upon the extent and severity of individual problem conditions is also included. Some reclamation approaches are discussed for the various problem conditions of exposed gob and slurry refuse, abandoned tipple areas, adjacent affected terrestrial and aquatic areas, and potentially hazardous or pollutional mine openings. However, it is suggested that each problem site will require a detailed appraisal of its associated problem conditions, environmental impacts, and reclamation costs before recommending and implementing a reclamation plan. (From authors' abstract) CE583

D77-58 SELECTIVE AGGLOMERATION IN THE TREATMENT OF FINE COAL REFUSE

Nicol, S. K. and Swanson, A. R., Australian Mining 69 (2), 42-43 (Feb. 1977). Fine coal is selectively agglomerated from refuse slurry by the addition of oil. The average ash content of the agglomerated product is about seven percent. The remaining material, with an ash content of about 85 percent, settled rapidly and produced a very clear supernatant liquid. CE829

D77-59 PLANT SYSTEM PROBLEMS: CAN WE EKE OUT PULVERIZED COAL WITH COAL-MINE WASHINGS?

O'Keefe, W., Power 121 (10), 134-135 (Oct. 1977). The experiences of several companies in using coal refuse as fuel are described. CE94

D77-60 OPERATING IDEAS: ELECTRICITY SOLIDIFIES SLIME MINE WASTE

Coal Age 82 (3), 109 (March 1977). A direct current of 100 to 400 volts is applied across mining refuse slurry using electrodes such as wire mesh fencing. The Bureau of Mines, Spokane Mining Research Center, has conducted

D77-60 (continued)

tests, which are described here, at lead-zinc-silver mines in Idaho and is investigating the application of the technique to coal processing-plant rejects. Jour, CE197

D77-61 PENNDOT: PUTTING COAL MINE WASTE TO GOOD USE

Transportation Engineering 47, 57 (Nov. 1977). The Pennsylvania Department of Transportation has used material from coal refuse piles in two road building projects. CE602

D77-62 PLANT CLEANS BANK OR RUN-OF-MINE

Coal Age 82 (9), 122-123, 126-127 (Sept. 1977). The modular coal washing plant described uses a rotating internally-scrolled water flood barrel for initial removal of coarse coal and heavy-media cyclones to remove the coal fines. Jour, CE647

D77-63 RECREATIONAL USE OF ANTHRACITE WASTELAND IN NORTHEASTERN PENNSYLVANIA; SUGGESTIONS FOR AN EVALUATION AND PLANNING PROCESS

Ramsauer, G., Economic Development Council of Northeastern Pennsylvania, in cooperation with U.S. Department of Agriculture, Northeastern Forest Experiment Station, Sept. 1977. 112 pp.+ Available, Economic Development Council of Northeastern Pennsylvania, P.O. Box 777, Avoca, Pennsylvania, 18641, and NTIS, FS-NE-4201. This broad socio-economic study includes consideration of the problems and potentialities of coal refuse banks and the development of the lands on which they are situated. CE608

D77-64 THE DISTRIBUTION OF ALUMINUM IN SHALES ASSOCIATED WITH THE MAJOR ECONOMIC COAL SEAMS OF EASTERN KENTUCKY

Robl, T. L. and Bland, A. E. (University of Kentucky), in "Proceedings Third Kentucky Coal Refuse Disposal and Utilization Seminar," Lexington, Kentucky, by University of Kentucky and Southeast Community College, May 11-12, 1977, J. G. Rose, Ed., Institute for Mining and Minerals Research, IMMR32-M4-77 (Dec. 1977). pp 97-101. Available, ORES Publications, College of Engineering, University of Kentucky, Lexington, Kentucky 40506. NTIS, PB-279 321/4WE. Several Al extraction processes are described, techniques for sampling and analyzing coal refuse are discussed, and the geochemistry and mineralogy of Kentucky refuse are described. Refuse examined from Eastern Kentucky was found to have a consistant chemical character (and hence predictability) with regard to the major coal seams, with Al_2O_3 concentrations falling into a range of 21 to 27 percent. The exception to this was the Hazard No. 4 refuse, with a much higher Al_2O_3 content (33-38 percent) due to the presence of an extensive flint clay splint of volcanic origin. The Western Kentucky refuse was found to be significantly lower in Al_2O_3, being more siliceous and having a large pyrite content. In addition to meeting the basic compositional requirements for acid processing, the Eastern refuse has several other attributes with regard to material cost, energy requirements, and composition, which enhance its attractiveness. 631 K3

D77-65 SINTERED COAL REFUSE AS A CONSTRUCTION AGGREGATE

Rose, J. G. (University of Kentucky), in "Proceedings Third Kentucky Coal Refuse Disposal and Utilization Seminar," Lexington, Kentucky, by University of Kentucky and Southeast Community College, May 11-12, 1977, J. G. Rose, Ed., Institute for Mining and Minerals Research, IMMR32-M4-77 (Dec. 1977). pp 59-63. Available, ORES Publications, College of Engineering, University of Kentucky, Lexington, Kentucky 40506. NTIS, PB-279 321/4WE. This paper reports on only one aspect of an extensive study at the University of Kentucky on coal refuse evaluation: the use of the quick-fired refuse as a lightweight aggregate in structural concrete, in bituminous (or asphalt) mixes, and in structural concrete block. (Adapted from author's Introduction) 631 K3

D77-66 SINTERED COAL REFUSE LIGHTWEIGHT AGGREGATE FOR HIGH-FRICTION BITUMINOUS SURFACE COURSES

Rose, J. G. and Decker, D. S. (University of Kentucky), Association of Asphalt Paving Technologists Annual Meeting, San Antonio, Texas, Feb. 1977. 33 pp. Bituminous coal refuse, a waste material from coal preparation plants, was sintered on a pilot-size traveling grate to produce lightweight (synthetic) aggregate. An improved continuous sintering process was used and is described with particular reference to lightweight aggregate production. Processing coal mine refuse in this facility produced lightweight aggregate of very low density with only minor external processing energy requirements. A thorough laboratory evaluation was conducted on the sintered aggregate using standard test procedures and classification systems. Reported test data indicates that the sintered aggregate is satisfactory for bituminous surfacing mixes, based on applicable criteria established by the American Society for Testing and Materials and the Texas Transportation Institute. Kentucky Bureau of Highways procedures were used to design and evaluate dense-graded surface mixes in which the coarse aggregate fraction, normally limestone, was replaced with an equivalent volume of sintered refuse. The Federal Highway Administration procedure was used to design and evaluate open-graded asphalt mixes, solely incorporating the sintered aggregate. It was determined that the mixes have acceptable levels of strength, stability, void content, water sensitivity, and other design parameters. Laboratory polishing/friction measurements indicate sintered coal refuse represents a potential source of high-friction, nonpolishing aggregate for the asphalt paving industry. (Authors' abstract) CE917

D77-67 PROPOSED COAL PILLARING PROCEDURE USING CONCRETE CONTAINING COAL REFUSE (COAL-CRETE)

Rose, J. G. and Howell, R. C., Mining Engineering 31 (3), 290-298 (March 1979). Also presented at AIME Annual Meeting, Atlanta, Georgia, March 1977. Preprint No. 77F102. In this laboratory study coal refuse was used as an aggregate in concrete mixes. It is proposed that the mixes be used to construct pillars to take the place of coal pillars which could then be recovered from room and pillar mines. Possible structural problems indicated by tests of the material are discussed. A detailed analysis of the economic feasibility compares the costs of using coal-crete to the costs of leaving the coal pillars and shows the latter case to be more attractive. Jour, D424

D77-68 RAPID MONITORING OF COAL REFUSE EMBANKMENTS

Roth, L. H., Cesare, J. A., and Allison, G. S., in Proceedings of the Conference on Geotechnical Practice for Disposal of Solid Waste Materials, University of Michigan, 1977. pp 428-443. The rapid monitoring system developed uses convergent and vertical photography from conventional fixed-wing aircraft. The system was tested on an active landslide and on two coal refuse facilities using both black and white and color infrared film. Field tests showed the system was capable of accurate measurement while providing qualitative data through photointerpretation. (From authors' abstract) CE956

D77-69 RAPID MONITORING OF COAL REFUSE EMBANKMENTS

Roth, L. H., Cesare, J. A., and Allison, G. S., CH2M Hill, Report to U.S. Bureau of Mines, Office of Assistant Director--Mining, BuMines OFR 11-78 (June 1977). 110 pp. NTIS, PB-277 975 The rapid monitoring system developed uses convergent and vertical photography from conventional fixed-wing aircraft. The system was tested on an active landslide and on two coal refuse facilities using both black and white and color infrared film. Field tests showed the system was capable of accurate measurement while providing qualitative data through photointerpretation. The accuracy of the system allows it to be used to monitor coal refuse embankments, tailings dams, major earth dams, and natural slopes. CE5

D77-70 SKY EYE MONITORS TAILINGS DAMS

Roth, L. H., Cesare, J. A., and Allison, G. S. (CH2M Hill), Coal Age 82 (8), 58-62 (1977). A method of measuring refuse bank movements that can precede embankment failure was developed for the Bureau of Mines. Eleven-inch diameter discs painted white and mounted on galvanized pipe are used as target and control points for aerotriangulation and regular interval photography. Analyses of the photographs show movements of the discs indicating slope movement, cracks, erosion, and downslope creep. Jour

D77-71 COAL SILT CONTROL IN PENNSYLVANIA

Siebert, C. L., Jr. (Pennsylvania Department of Environmental Resources, Industrial Wastes Division), Water Pollution Control Association of Pennsylvania Magazine 10 (1), 8-13 (Jan.-Feb. 1977). The author describes the effects of coal washery water on the rivers and streams of the anthracite region of Pennsylvania before water pollution control was practiced. Visible improvements resulted from methods of clarifying waste water developed in response to legislation. D495

D77-72 SOLIDIFICATION OF FINE COAL REFUSE

Snyder, G. A. (1), Zuhl, F. A. (1), and Burch, E. F. (2) [(1) Dravo Lime Co. and (2) Island Creek Coal Co.], Mining Congress Journal 63 (12), 43-46 (Dec. 1977). Also presented, American Mining Congress Coal Convention, Pittsburgh, Pennsylvania, May 1-4, 1977. Session Papers, Set No. 4. 12 pp.+ Laboratory tests on refuse from approximately two dozen preparation plants showed that the Calcilox additive process remedied some materials handling problems

D77-72 (continued)

associated with disposal methods of fine coal refuse. For plants using settling ponds, this stabilization technique produced a solidified dry material that was easily excavated and landfilled. Calcilox additives were especially advantageous when used in preparation plants' thickener underflow and pumped to a permanent impoundment. There, strength was gained as the material stabilized into a solid mass, and the potential of surface or ground water contamination from leaching of the ponded material was reduced. The additive was also useful in stabilizing filter and centrifuge cake from dewatering devices. Jour, CE381

D77-73 ANTHRACITE REFUSE BANKS RECLAIMED WITH SLUDGE AND EFFLUENT TREATMENTS

Sopper, W. E., Kardos, L. T., and Edgerton, B. R., Science in Agriculture 24 (2), 8-9 (Winter 1977). This review of the research carried out on a burnt anthracite refuse bank gives tables summarizing the results of revegetation after one growing season. Municipal sludge was shown to be beneficial with best results from applications of moderate amounts of sludge. CE605a

D77-74 A REVIEW OF THE POTENTIAL FOR UTILISING WASHERY REFUSE IN N.S.W. AND QUEENSLAND

Sullivan, K. M., Australian Coal Industry Research Laboratories Ltd., P.R. 77-10 (June 1977). 13 pp. This review indicates that potential areas of use of coal refuse will be as a fuel; as a potential fuel replacement and raw material additive for brick manufacture; as a raw material for lightweight aggregate manufacture; as a construction material; for agricultural purposes, or a number of other areas of special use. The successful marketing of coal refuse will depend on an in-depth technical market analysis being carried out, followed by practical research and a comprehensive product examination and identification programme being undertaken. (From author's Summary) 662.6 A9

D77-75 SOME ECONOMIC ASPECTS OF COAL PREPARATION

Symonds, D. F. (Birtley Engineering Corp.), in "Proceedings Third Kentucky Coal Refuse Disposal and Utilization Seminar," Lexington, Kentucky, by University of Kentucky and Southeast Community College, May 11-12, 1977, J. G. Rose, Ed., Institute for Mining and Minerals Research, IMMR32-M4-77 (Dec. 1977). pp 5-9. Available, ORES Publications, College of Engineering, University of Kentucky, Lexington, Kentucky 40506. NTIS, PB-279 321/4WE. Coal preparation methods, ranging from no washing through partial washings to total washing with and without thermal dryings, are compared. It is noted that with partial washing, only "the coarse material which can be mechanically dried to a low moisture content is washed;---Waste disposal is limited to solid materials and the quantities of waste material to be handled are greatly reduced." 631 K3

D77-76 THE PREVENTION AND UNDERGROUND DISPOSAL OF EXTRANEOUS DIRT

Turner, C. W. (National Coal Board, South Yorkshire Area), The Mining Engineer 137 (197), 195-203 (Nov. 1977). The sources of extraneous refuse production

D77-76 (continued)

during coal mining operations are examined. Several steps to reduce the trend are suggested. It is claimed that the costs expended in installing systems described in this paper can be regained through savings from reduced transport costs. Jour

D77-77 UTILISATION OF COLLIERY SPOIL IN CIVIL ENGINEERING APPLICATIONS

National Coal Board, London, Contract No. 6220-73/8/805, Commission of the European Communities, coal research reports, EUR 5736 e (1977). (41 pp.) The chemical and mineralogical composition of a number of colliery spoils (coal refuse materials) has been determined but it has not proved possible to relate these to the mechanical properties of the materials. The normal aggregate tests applied to dry materials have been shown to be unreliable as guides to the behaviour of minestones once they have been wetted. This applies to minestones wetted for best compaction as fill and to minestones to which ordinary Portland cement has been added for stabilisation. It is shown that three laboratory tests (water absorption, wetting expansion and the moisture content required to achieve maximum dry density) are the best criteria for predicting the mechanical strength of minestone stabilised with cement. Precast concrete blocks have been made from tailings and cement and their mechanical properties are such, that with suitable reinforcement they could be used as substitutes for the timber blocks currently employed for strata control. Anthracitic and bituminous coal spoils have been converted into acceptable lightweight aggregates by sintering on static grates thereby simulating the sinterstrand process. Means for suppressing the emission of tar fumes during processing have been investigated and a low-temperature carbonisation stage prior to sintering has been shown to reduce tar emission substantially without impairing product quality. (Summary of the Report) CE584

D77-78 PROBLEMS RELATED TO COAL PREPARATION PLANT DESIGN AND CONSTRUCTION

West, T. W. (Dravo Corp.), in "Proceedings Third Kentucky Coal Refuse Disposal and Utilization Seminar," Lexington, Kentucky, by University of Kentucky and Southeast Community College, May 11-12, 1977, J. G. Rose, Ed., Institute for Mining and Minerals Research, IMMR32-M4-77 (Dec. 1977). pp 11-14. Available, ORES Publications, College of Engineering, University of Kentucky, Lexington, Kentucky 40506. NTIS, PB-279 321/4WE. The emphasis in this paper is on communication between preparation plant owners and contractors in order that the owner's expectations are met. 631 K3

D77-79 SEASONAL VARIATION IN THE AVAILABILITY OF PLANT NUTRIENTS IN ACID COLLIERY SPOIL

Williams, P. J. and Chadwick, M. J. (University of York, U.K.), Journal of Applied Ecology 14 (3), 919-931 (1977). The Mitchell's Main refuse pile near Barnsley, South Yorkshire, was the site of studies using several kinds of soil amendments. This paper describes results on plots receiving a single application of ground limestone. A saturated paste extract was used in determining concentrations of aluminum, manganese, copper, zinc, iron, sodium,

D77-79 (continued)

potassium, calcium, and magnesium. In summer and autumn, pH of the refuse pile material was lower, and extractable aluminum, manganese, copper, zinc, and iron were greater than in winter and spring. Limestone addition significantly increased pH of the refuse material and reduced amounts of extractable aluminum, manganese, zinc, iron, and copper. CE591

D77-80 THE PUMPED PACK SYSTEM AT MARKHAM MAIN COLLIERY

Wills, N. B. (Doncaster Metropolitan Institute of Higher Education, U.K.), Colliery Guardian 225 (12), 901-906 (Dec. 1977). The use of screened minus 20-15 mm material from run of mine coal in the formation of a pumped pack system is described. Fines are mixed at a constant speed with water and "Flowmat", a form of bentonite, to assure the correct consistency of the final product. After two hours, the pack attains a crushing strength of 65 pounds per square inch; maximum crushing strength is reached in approximately one month. Jour

D77-81 SOURCES OF CANADIAN NON-BAUXITE ALUMINA

Winer, A. A. (Canada Department of Energy, Mines and Resources), in "Proceedings Third Kentucky Coal Refuse Disposal and Utilization Seminar," Lexington, Kentucky, by University of Kentucky and Southeast Community College, May 11-12, 1977, J. G. Rose, Ed., Institute for Mining and Minerals Research, IMMR32-M4-77 (Dec. 1977). pp 103-106. Available, ORES Publications, College of Engineering, University of Kentucky, Lexington, Kentucky 40506. NTIS, PB-279 321/4WE. Coal shale and coal washing rejects from Canadian coal production are among the materials investigated as potential sources of alumina. 631 K3

D77-82 ABANDONED COAL MINE REFUSE AREAS: THEIR RECLAMATION AND USE

Zellmer, S. D. and Carter, R. P. (Argonne National Laboratory), American Society of Agricultural Engineers, Winter Meeting, Chicago, Illinois, Dec. 13-16, 1977. Paper No. 77-2515 (18 pp.) The gob pile at abandoned Mine No. 14 of Consolidated Coal in Staunton, Macoupin County, Illinois, was chosen as a reclamation project demonstration site for several reasons. The land had little economic value, the acidic leachate had deteriorated the surface and ground water, and the community was in need of more recreational lands. After a wealth of data was accumulated to determine the pre-reclamation baseline conditions, detailed engineering plans for site development were completed and executed. Following regrading, neutralizing and stabilizing, an additional application of five tons per acre of agricultural limestone and 120 lbs per acre of N, P, and K were disked in to a depth of four inches and a seedbed was prepared. Post-reclamation evaluation indicates success in improving surface water quality, a decrease in acidity, sulfate, and heavy metals, and an increase in pH. CE374

D78-1 EFFECT OF COMPACTION OF COAL SHALE ON THE REVEGETATION OF SPOIL HEAPS

Ayerst, J. M. (Crewe and Alsager College, Cheshire, Great Britain), Reclamation Review 1 (1), 27-30 (March 1978). Soil strength was measured at several places in a North Staffordshire Colliery where machinery was operating and compacting refuse over which it passed. The measurements showed that compaction increased soil strength above the levels identified as that required to inhibit root growth. Reference is made to field studies showing roots failing to penetrate compacted soils and seedlings dying from dehydration as the surface dried. While fertilizer increased root growth, the use of sewage sludge reduced the increase in soil strength, and therefore enhanced growth, better than did high-nitrogen inorganic fertilizer. Jour, R985a

D78-2 ALUMINUM AND MANGANESE TOXICITIES IN ACID COAL MINE WASTES

Berg, W. A. (Colorado State University), in "Environmental Management of Mineral Wastes," G. T. Goodman and M. J. Chadwick, Eds., Alphen aan den Rijn, The Netherlands: Sijthoff & Noordhoff, 1978. pp 141-150. In this review of the literature, evidence of manganese and aluminum toxicities to plants is discussed and related to toxicity of these elements on acid coal mine wastes and spoils. It is shown that, on coal wastes, aluminum is a major cause of plant toxicity, while manganese may be a problem for growth of legumes but seldom a problem for perennial grasses. R1001

D78-3 RECOVERING FINE-SIZE COAL FROM ALABAMA UNDERGROUND MINE WASHER WASTES USING THE HUMPHREYS SPIRAL

Browning, J. S., Alabama Mineral Resources Institute and State Mine Experiment Station, MRI Technical Report Series, T. R. Number 4 (1978). 8 pp. The Mineral Resources Institute and State Mine Experiment Station of The University of Alabama conducted Humphreys spiral tests of fine coal waste from nine preparation plants of Alabama underground mining operations, to determine the feasibility of recovering low ash and sulfur fuel meeting steam coal specifications. The ash in the samples ranged from 19.0 to 41.9 percent, and the total sulfur ranged from 0.68 to 1.33 percent. Continuous laboratory tests using a Humphreys spiral gave good recovery of the coal with excellent rejection of the ash and pyritic sulfur. Coal recoveries of 95.6 to 97.5 percent were achieved from the different samples. Ash content of the clean coal products fell within a range of 8.1 to 8.7 percent, with a total sulfur content of 0.81 to 1.29 percent. In quality, the products were comparable or superior to those now being shipped from the preparation plants. (Author's abstract) Ala

D78-4 RECOVERY OF FINE-SIZE WASTE COAL

Browning, J. S., University of Alabama, Mineral Resources Institute, Final Report as of May 1978 to U.S. Department of Energy, Division of Fossil Fuel Extraction, Mining Research and Development, FE-9005-1 (Nov. 1978). 46 pp. Existing waste impoundments in Alabama were surveyed to determine their

D78-4 (conntinued)

location, the approximate quantity of coal in each waste pond, and the amount of recoverable coal based on washability tests of representative samples of the waste. Humphreys spiral tests were conducted on Alabama fine coal waste from nine preparation plants of surface mining operations, and from nine preparation plants of underground mining operations. The ash in the samples ranged from 9 to 51 percent, and the total sulfur ranged from 0.54 to 2.39 percent. Continuous laboratory tests using a Humphreys spiral gave good recovery of the coal with excellent rejection of the ash and pyritic sulfur. Ash content of the clean coal products fell within a range of 5 to 12 percent, with a total sulfur content of 0.42 to 1.29 percent. Coal recoveries (float 1.60 specific gravity) of 84 to 98 percent were achieved from the different samples. In quality, the products were comparable or superior to those now being shipped from the preparation plants. (Author's abstract) DOE

D78-5 CHARACTERIZATION OF COAL REFUSE

Buttermore, W. H., Simcoe, E. J., and Maloy, M. A., West Virginia University, Coal Research Bureau, Report No. 159 (undated). 137 pp. The purpose of this study is to determine the composition of bituminous coal wastes and determine whether significant variance can be expected according to geographical area. Sample sites in the study were selected to represent the largest producing areas or bituminous coal mining districts of the United States. Within each district specific sample sites were chosen based upon production data. Large producers with "typical" preparation facilities were singled out and samples of waste obtained. Where possible, both coarse and fine waste materials were sampled. Coarse samples were split, and bulk density and screen size analyses were performed. Slurry concentration was carried out on the fines or slurry. Mineral content and physical and chemical properties were also determined. Based upon the results of the analyses presented in the report, no consistent, significant variance was noted according to geographical source. (Adapted from authors' Introduction) CE685

D78-6 SOURCE ASSESSMENT: COAL REFUSE PILES, ABANDONED MINES AND OUTCROPS, STATE OF THE ART

Chalekode, P. K. and Blackwood, T. R., Monsanto Research Corporation, Report to U.S. EPA, Industrial Environmental Research Laboratory, Cincinnati, Ohio, EPA-600/2-78-004v (July 1978). 39 pp. The extent, environmental effects, and means of controlling fires in coal refuse, abandoned mines, and at outcrops are presented from the literature. Calculations are shown for determining the "source severity" and the "affected population." Emissions from a representative burning refuse bank were sampled and analyzed for gas flow, total and respirable particulates, hydrocarbons, sulfur and nitrogen oxides, carbon monoxide, ammonia, and hydrogen sulfide. Analyses for polycyclic organic material and trace elements were carried out on the samples of particulates. EPA, CE615

D78-7 PERFORMANCE OF LAMELLA THICKENERS™ IN COAL PREPARATION PLANTS

Cook, R. L. (1) and Childress, J. J. (2) [(1) Parkson Corp. and (2) Childress Corp.], Mining Engineering 30 (5), 566-571 (May 1978). An explanation of basic settling design is used to present the advantages of this inclined, shallow depth, sedimentation device. The Lamella Thickener offers uniform flow distribution throughout the settler by lowering pressure at the discharge site; avoids mixing sludge with incoming feed by separating the feed, effluent, and sludge streams; and takes up less space than conventional thickeners. The Lamella Thickeners' plates are angled from 45 to 60 degrees so the sludge will be self-draining. A number of full-scale installations have handled various flow rates and produced effluents suitable for recycled water and sludges with densities adequate for vacuum filtration. Jour

D78-8 THE NUTRIENT BUDGET OF COLLIERY SPOIL TIP SITES. I. NUTRIENT INPUT IN RAINFALL AND NUTRIENT LOSSES IN SURFACE RUN-OFF

Dennington, V. N. and Chadwick, M. J. (University of York, U.K.) J. Applied Ecology 15 (1), 303-316 (1978). The nutrient inputs from rainfall at three refuse piles in industrial South Yorkshire are compared with rainfall nutrients at a rural site. One refuse disposal area had been revegetated with grasses and trees, one had no treatment but was being revegetated by volunteer plants, and, at the third site, early reclamation efforts were unsuccessful. Nutrients studied were sodium, potassium, calcium, magnesium, phosphorus, and several forms of nitrogen. The main difference in input between the sites was a consistently high sodium-potassium ratio recorded in the rainfall at the rural site. Loss of nutrients from runoff was also monitored, with the finding of a net loss of sodium, calcium and magnesium from bare spoil but net gains of nitrogen, phosphorus and potassium from rainfall. CE593

D78-9 COAL REFUSE UTILIZATION IN ROAD CONSTRUCTION

DiMillio, A. F. and Besselievre, W. C. (Federal Highway Administration, Washington, D.C.), in "Proceedings Fourth Kentucky Coal Refuse Disposal and Utilization Seminar," Pine Mountain State Park, Pineville, Kentucky, by University of Kentucky, Pikeville College, and Harlan County Coal Operators Association, June 6-7, 1978, J. G. Rose and R. W. De Vore, Eds., Institute for Mining and Minerals Research, IMMR40-RRR5-78 (Dec. 1978). pp 41-47. Available, ORES Publications, College of Engineering, University of Kentucky, Lexington, Kentucky 40506 This paper discusses the current efforts of the FHWA Offices of Research and Development in determining the proper utilization of coal refuse in road construction. The Office of Development is preparing a Users Manual for Coal Refuse in Highway Embankments, and the Office of Research is investigating the use of coal refuse/fly ash compositions as a pavement base course material. Both of these contract studies are in the early stages of performance; however, details of current progress and future plans are highlighted. (Authors' abstract) 631 K3, CE844d

D78-10 DONCASTER CARR PROJECT

Surveyor 151 (4485), 16 (May 25, 1978). The possibility is discussed of using both currently produced coal washery refuse and material from refuse piles as

D78-10 (continued)

fill in a low-lying area in Doncaster being reclaimed as an industrial site. CE595

D78-11 STABILIZING A COAL REFUSE PILE

Dronen, S. I. and Pendleton, C. S. (Soil Conservation Service), Soil Conservation 43 (11), 20-21 (June 1978). The successful establishment of woody plants, grasses, and legumes on a 400-foot-high, 30 acre, 20-year-old coal-waste pile at the Clinchfield Coal Company in Lebanon, Virginia, is described. CE837

D78-12 MINING WASTE

Dunn, R. B., Mining Technology 60 (694), 319-327 (Aug. 1978). This general review discusses the production of coal refuse, methods of refuse disposal and associated problems, and the possibilities for utilization of refuse. D248

D78-13 DENSE AGGREGATE FROM COLLIERY WASTE

Everett, R. H. and Hodgkinson, N. (to Coal Industry Patents, Ltd.), British Patent 1,526,145 (Sept. 27, 1978). 6 pp. According to this patent, coal refuse is treated in a fluidized bed which is maintained at a temperature at which combustible material in the refuse is completely burned. Fines entrained in gases emerging from the bed are removed from the gases, formed into agglomerates, and fired to give a dense aggregate. Brit Pat, CE759

D78-14 RELEASE OF TRACE ELEMENTS FROM A BURNING BITUMINOUS CULM BANK

Finkelman, R. B., U.S. Geological Survey, Open File Report 78-864 (1978). 49 pp. The burning refuse bank which was the subject of this investigation is situated at Mather, about seven miles east of Waynesburg, in southwestern Pennsylvania. Samples of the materials forming on the surface of the bank, the gases escaping from vents and the water and sediment from nearby South Fork of Tenmile Creek, a tributary of the Monongahela River, were analyzed to determine the presence of trace elements. Copper was the only element of potential environmental significance found to be accumulating on the Mather Bank, but it was not anomalously high in sediments in the vicinity of the bank nor in waters immediately downstream. Relatively high concentrations of arsenic were found in the organic matter at the base of the bank but no evidence of high arsenic values was found downstream. No potentially toxic elements, other than sulfur, were detected in the gases being emitted from the refuse bank. (Adapted from author's abstract) US Geol Fiche

D78-15 WASTE PRODUCTS TO FERTILE SOIL. THE COMBINATION OF FLUE GAS DESULFURIZATION SLUDGES AND FINE COAL REFUSE WITH MUNICIPAL WASTE

Freas, R. C. and Briggs, R. W., Proceedings of the Sixth Mineral Waste Utilization Symposium, Chicago, Illinois, by U.S. Bureau of Mines and IIT Research Institute, E. Aleshin, Ed., 1978. pp 70-75. Available, IIT Research Institute, P. O. Box 4963, Chicago, Illinois 60680 More than 240 mixes were

D78-15 (continued)

prepared for seeding and growth tests. Both the refuse and flue-gas-desulfurization (FDS) sludges were stabilized with Calcilox. In this paper, the physical properties of selected samples are tabulated and compared to a desirable fertile soil. Pot growth tests showed that although the mixtures would support plant growth, the species used varied in their rate of germination and growth. Analyses of plant material showed that plants also varied widely in their ability to accumulate various elements. 622 M6 1978

D78-16 THE DISPOSAL OF COAL MINE SPOIL IN THE UNITED KINGDOM

Glover, H. G. (National Coal Board, U.K.), in "Environmental Management of Mineral Wastes," G. T. Goodman and M. J. Chadwick, Eds., NATO Advanced Study Institute Series, Series E: Applied Science - No. 7, Alphen aan den Rijn, The Netherlands: Sijthoff & Noordhoff, 1978. pp 35-69. The author discusses the extent of the problem in Great Britain, characteristics of refuse and changes in these characteristics during weathering, reclamation of refuse disposal sites, and possible uses of coal refuse. 631 G65

D78-17 AGGLOMERATION OF COAL FINES

Holley, C. A. (1) and Antonetti, J. M. (2) [(1) Ferro-Tech, Inc. and (2) Calgon Corp.], in Proceedings of the Institute for Briquetting and Agglomeration, 15th Biennial Conference, Montreal, Quebec, Aug. 1977 (Published 1978). pp 1-12. Available, Executive Director, W. W. Eichenberger, Erie Briquetting Co., P. O. Box 794, Erie, PA 16512. Agglomeration of coal fines by pelletizing is compared to agglomeration by extrusion and by briquetting. The pelletizing pilot plant at Bologna Mining Company in Burgettstown, Pennsylvania, is described. Coal fines reclaimed from slurry ponds and treated by froth flotation to reduce ash content are mixed with binder and formed into pellets with satisfactory handling strength. Experience in pelletizing coal fines at the Eastern Coal Company plant, Stone, Kentucky, is also reviewed. IBA

D78-18 REFUSE DEWATERING BY CENTRIFUGES

Iwasyszyn, T. (Centrifugal & Mechanical Industries, Inc.), in "Proceedings Fourth Kentucky Coal Refuse Disposal and Utilization Seminar," Pine Mountain State Park, Pineville, Kentucky, by University of Kentucky, Pikeville College, and Harlan County Coal Operators Association, June 6-7, 1978, J. G. Rose and R. W. De Vore, Eds., Institute for Mining and Minerals Research, IMMR40-RRR5-78 (Dec. 1978). pp 55-56. Available, ORES Publications, College of Engineering, University of Kentucky, Lexington, Kentucky 40506 Examples are given of the use of vertical vibratory centrifuges in dewatering refuse from a heavy media vessel, from heavy media cyclones processing Lower Elkhorn Seam coal, and refuse from Deister tables washing Chilton Seam coal. 631 K3, CE844f

D78-19 CONVEYING LIMESTONE AGGREGATES AND COLLIERY SPOIL BY HYDRAULIC PIPELINE: TRIALS WITH A 156MM DIAMETER PIPE

James, J. G. and Broad, B. A., Transport and Road Research Laboratory, Crowthorne, England, TRRL-SUPPLEMENTARY-354 (1978). 46 pp. NTIS, PB-279 131. The tests described in this Report involved pumping limestone aggregates and colliery spoil up to 50mm in size, as slurries with water, through a test loop of 156mm diameter steel pipe, and measuring the headloss with a range of concentrations and velocities. The effect of each variable has been shown in a series of graphs and from the data obtained the necessary operating pressures and energy requirements calculated for full-scale pipelines. Tentative extrapolations have been made for pipes of larger diameters pending further data. When conveying colliery spoil it was found that the combination of water and agitation rapidly broke down the shales and mudstones which form the major part of the spoil until the operating characteristics became those of a fine-particle slurry pipeline. It is assumed that in practice, the disposal of colliery spoil by slurry pipeline would therefore be assisted by some simple pre-treatment to reduce it to this condition. At a concentration of 15 per cent by volume a velocity of 2m/s would then be ample. Under these conditions the headloss in the 156mm pipe was found to be about 40 metres of water per kilometre of pipe and the specific energy less than 0.4 kilowatt hours per tonne kilometre. A similar reduction in these values for pipes of larger diameters is anticipated. (From authors' Conclusions) CE596

D78-20 IMPROVEMENTS IN OR RELATING TO THE PACKING OF DEBRIS IN MINES

Japp, F. and Hilton, R. (to Gullick Dobson Ltd.), British Patent 1,502,284 (March 1, 1978). 7 pp. This patent covers modifications to a packing apparatus such that the series of packing or ramming devices "May be operated sequentially in any desired or predetermined phase relationship and not necessarily on numerical order or some other fixed relationship." Brit Pat, CE624

D78-21 STUDY OF UNDERGROUND COAL MINE WASTE DISPOSAL REQUIREMENTS IN THE UNITED STATES

Kaufman, W. W. and Williams, J. R., Skelly and Loy, Engineers and Consultants, Report to U.S. Bureau of Mines, Office of Director--Minerals Health and Safety Technology, BuMines OFR 6-80 (Oct. 20, 1978). NTIS, PB80-134646. Regulations for coal refuse disposal by eight states and eight Federal Agencies have been compiled and their technical and economic impacts have been determined. The states were grouped into four regions for the study: Region I, Pennsylvania, northern West Virginia and Ohio; Region II - southern West Virginia, eastern Kentucky and Virginia; Region III - Illinois and western Kentucky; and, Region IV - Colorado and Utah. The eight federal agencies surveyed are as follows: 1. Mine Safety and Health Administration, Department of Labor, 2. Environmental Protection Agency, 3. Forest Service, Department of Agriculture, 4. Bureau of Land Management, 5. Geological Survey, 6. Bureau of Indian Affairs, 7. National Park Service, and 8. Office of Surface Mining Control and Reclamation, 4. through 8., all in the Department of Interior. The report also includes a brief description of coal waste characteristics and disposal practices; a review of significant

D78-21 (continued)

historical regulatory trends; a projection of future trends; and a list of recommendations which may help to improve refuse disposal methods and the regulatory process. (From authors' Executive Summary and Introduction) 360.000 78-1

D78-22 CHEMICAL VARIATION AND VEGETATION DISTRIBUTION ON A COAL WASTE TIP

Kimber, A. J., Pulford, I. D., and Duncan, H. J., Journal of Applied Ecology 15 (2), 627-633 (1978). Fifty-four samples were collected from a regraded refuse pile in Scotland where there had been no planned revegetation. Among the volunteer plants in all areas of the pile were healthy specimens of Chamaenerion angustifolium (rose bay willow herb) which is tolerant to a wide range of pH. The samples were divided into burnt and unburnt material. The unburnt material was classified, on the basis of pH and extractable sulfate, as "pre-acid" or "acid" material. Analyses of refuse and of dried plant material showed large variations in composition and also showed that the nutrient and trace metal contents of Chamaenerion angustifolium could be predicted by the acetic acid extractable levels of elements from the refuse area on which it was grown. D440

D78-23 NEW TRENDS IN FINE REFUSE VACUUM FILTRATION

Klepper, R. P. (Envirotech Corporation), in "Proceedings Fourth Kentucky Coal Refuse Disposal and Utilization Seminar," Pine Mountain State Park, Pineville, Kentucky, by University of Kentucky, Pikeville College, and Harlan County Coal Operators Association, June 6-7, 1978, J. G. Rose and R. W. De Vore, Eds., Institute for Mining and Minerals Research, IMMR40-RRR5-78 (Dec. 1978). pp 51-54. Available, ORES Publications, College of Engineering, University of Kentucky, Lexington, Kentucky 40506 This paper discusses the parameters that directly and indirectly affect the operation of fine refuse vacuum filtration, and also several new evolutionary designs and operational innovations that can increase the efficiency of fine refuse dewatering. (From author's abstract) 631 K3, CE844e

D78-24 METHOD OF TREATING EARTHEN AREAS

Kobeski, W. D., Srocki, S. W., Blosser, W. I., and Needham, J. J. (to United States Gypsum Company), U.S. Patent 4,076,862 (Feb. 28, 1978). 8 pp. In this method, an aqueous slurry of calcium sulfate hemihydrate is formed with a small amount of defoamer, using a quantity of water about 25-56 percent above normal consistency. The slurry is sprayed onto the barren area to form a set, substantially air-impermeable covering that will exclude outside air from the area. The method is particularly applicable to controlling burning coal refuse and inhibiting spontaneous combustion of coal refuse banks. (Adapted from abstract of the disclosure) CE626

D78-25 WHERE SHALL WE PUT THE COLLIERY WASTES?

Lindley, T., Surveyor 151 (4485), 13-16 (May 25, 1978). The problem of storage and disposal of coal mining and coal cleaning refuse in Great Britain

D78-25 (continued)

is discussed. Reclamation of old refuse piles and some possible methods of handling and transporting currently produced material are described. CE594

D78-26 CHEMICAL STABILIZATION ENDS FINE COAL REFUSE PROBLEMS

Longfellow, R. L. (Dravo Lime Co.), Coal Mining & Processing 15 (1), 63-65 (Jan. 1978). The hardening of high moisture coal refuse fines with Calcilox is described. Cementatious type reactions are initiated by the proprietary material, which was developed by Dravo Lime Company, hardening the sludge and allowing it to be handled easily. Jour, CE403

D78-27 PROCESS FOR THE SEPARATION OF AGGLOMERATED CARBONACEOUS PARTICLES FROM ASSOCIATED INORGANIC MATERIALS

McMurray, R. L., U.S. Patent 4,089,776 (May 16, 1978). 6 pp. This patent describes the design of an apparatus which can be used for fine coal recovery. The refuse slurry plus a liquid hydrocarbon is fed into the vertical middle of a tank where the float-sink separation takes place. The mixture is aggitated in this tank, and the inorganic (sink) material removed from the bottom of the tank by an auger which discharges above the level of the liquid in the tank, thus promoting the dewatering of the refuse. US Pat, CE690

D78-28 FLUIDIZED-BED COMBUSTION TEST OF LOW-QUALITY FUELS--I. ANTHRACITE REFUSE

Mei, J. S., Gall, R. L., and Wilson, J. S., U.S. Department of Energy, Morgantown Energy Research Center, MERC/RI-78/1 (May 10, 1978). 50 pp. A total of five types of anthracite refuse material with widely different characteristics have been successfully burned in the 18-inch diameter atmospheric pressure fluidized-bed combustor at the Morgantown Energy Research Center. Combustion characteristics of these anthracite refuse materials as well as engineering data were investigated for a wide range of operation conditions. Values of carbon combustion efficiency, sulfur dioxide and nitrogen oxides, heat transfer and heat release rates together with the analysis of ash content are presented. Results of this systematic study of the fluidized-bed combustion of anthracite refuse material indicate that a substantial amount of heating value contained in this rejected material can be recovered. (From authors' abstract) DOE

D78-29 MECHANISED PACKING FOR LONGWALL COAL FACES: FACE-END SYSTEMS AND PACKING EQUIPMENT

Mine and Quarry 7 (1/2), 40, 43-44, 47 (Jan./Feb. 1978). Different packing operations with longwall mining and the use of mining dirt as a packing material are described. Jour

D78-30 A SURVEY OF THE DISPERSAL OF COLLIERY WASTE FROM LYNEMOUTH BEACH, NORTHUMBERLAND

Nunny, R. S., Ministry of Agriculture and Food, Great Britain, Directorate of Fisheries Research, Lowestoft, Fisheries Research Technical Report No. 43 (1978). 17 pp. A survey of Lynemouth Beach and nearby coastal areas in northeastern England was carried out during October and November 1930. Coal refuse had been disposed of on Lynemouth Beach since before 1930. Coal seams also outcrop along the shoreline in this area. The report describes the sampling of the beach, intertidal and sea-bed areas, the dynamics of wave movement of beach sediments, the different types of beach material and offshore sediments found, the history of refuse disposal on Lynemouth Beach, and evidences of consequent refuse dispersal. Among the conclusions of the study are that refuse disposed along the high water mark at Lynemouth is actively reworked by wave action; only material fine enough to be carried in suspension through the decreased turbulence on the seaward side of breaking waves escapes offshore, most material being trapped within local bays; except for some coal found at Newbiggin, just south of Lynemouth, "there is no evidence that significant amounts of beach material are being transported out of Lynemouth Bay by littoral drift." D240

D78-31 ACIDITY AND NUTRIENT AVAILABILITY IN COLLIERY SPOIL

Palmer, M. E. (University of York, U.K.), in "Environmental Management of Mineral Wastes," G. T. Goodman and M. J. Chadwick, Eds., NATO Advanced Study Institute Series, Series E: Applied Science - No. 7, Alphen ann den Rijn, The Netherlands: Sijthoff & Noordhoff, 1978. pp 85-126. In samples of spoil from the weathered surface of colliery tips in the East Pennine coalfield of Britain the pH values ranged from pH 8.0 down to pH 2.4. Extreme acidity in these materials is due to oxidation of iron pyrites in the debris. The resulting acid sulphate medium is buffered by reaction with the clay mineral component of the debris. Weathering of the host minerals for phosphate, magnesium and manganese is extremely rapid under these conditions. At low pH values potassium is precipitated as Jarosite and the level of plant available potassium is greatly reduced. Behavior of a number of trace elements in coal refuse are also discussed. (Adapted from author's abstract) 631 G65

D78-32 SUBSIDENCE-CONTROL PROJECT IN THE BELLEVILLE-MARYVILLE AREA, ILLINOIS

Paone, J., Cox, R. H., and Allen, A. S. (U.S. Bureau of Mines, Washington, D.C.), AIME-SME Fall Meeting and Exhibit, St. Louis, Missouri, 1977. Preprint No. 77-F-339. 22 pp. Also published in Mining Engineering 30 (2), 183 (Feb. 1978). The project to inject fine refuse into abandoned underground mines by means of a pneumatic system is described. Because the mines were found to be dry and also with soft clay floors which would lose strength when wet, hydraulic backfilling was not considered advisable. AIME, Jour

D78-33 FLUIDIZED BED COMBUSTION OF FLOTATION TAILINGS

Poersch, W. and Zabeschek, G. (Babcock-BSH A.-G., Krefeld, West Germany), in "Proceedings of the Second Engineering Foundation Conference," Trinity College, Cambridge, England, April 2-6, 1978, J. F. Davidson and D. L.

D78-33 (continued)

Keairns, Eds., London, England: Cambridge University Press, 1978. pp 292-296. The subject of this report is the incineration of flotation slurries containing varying amounts of carbon in a pilot fluidized bed combustor. Thermally pre-dried flotation slurries yielded higher combustion efficiencies than mechanically dewatered slurries, the latter ones dispersed satisfactorily only at solids contents of not more than 55%. To keep the emission of sulphur dioxide in the flue gas at the lowest possible level, additives of varying mean particle size were admixed to the flotation slurries. By the addition of limestone fines in mole ratios of about 2, desulphurization efficiencies of 90% could be safely obtained. In carrying out these tests, it was essential to control the composition of the ash obtained so as to allow its further processing in the production of building materials. (Authors' Synopsis) 660 F25

D78-34 POLLUTION CONTROL GUIDELINES FOR COAL REFUSE PILES AND SLURRY PONDS

W. A. Wahler and Associates, Interagency Energy-Environment Research and Development Program Report to U.S. EPA, Industrial Environmental Research Laboratory, Cincinnati, Ohio, EPA-600/7-78-222 (Nov. 1978). 214 pp. It was concluded that environmentally acceptable refuse piles and slurry ponds can be developed and operated using current technology. For refuse piles, proper layering and compaction techniques, drainage control, diversion of surface and ground waters around refuse piles, and ongoing reclamation of finished surfaces by covering them with selected materials and promoting vegetative growth will combine to reduce both air and water pollution. The problem of acid water drainage through dams or abutments, as well as the problem of suspended solids in waters from slurry ponds can be minimized by: (1) properly discharging slurry into ponds and maximizing slurry travel distance through the ponds to obtain maximum settling of suspended solids; (2) proper design of slurry retention dams; (3) avoiding large flowthroughs of runoff from upstream drainage areas; (4) returning clarified pond waters to preparation plants for reuse; (5) isolating contaminated seepage waters from ground and suface waters; and (6) collecting seepage below retention dams, treating it (if necessary), and releasing it or pumping it back to the slurry ponds. (From authors' abstract) EPA, CE644

D78-35 PROCESSOR USES GERMAN PREP PLANTS

Coal Age 83 (4), 99-102 (April 1978). Corcol Energy, Inc., is operating a cleaning plant which is recovering coal from refuse in Virginia and another which cleans run-of-mine metallurgical coal at a West Virginia mine. Refuse slurry is dewatered in cyclones and centrifuges, and finally sent to deep-cone thickeners. The flowsheet for the entire process is shown. Jour

D78-36 THE INFLUENCE OF ACID LEACHING AND IGNITION ON THE AVAILABILITY OF NUTRIENTS IN COAL MINE WASTE

Pulford, I. D. and Duncan, H. J., Reclamation Review 1 (2), 55-59 (1978). Samples of burnt and unburnt coal refuse collected from sites in central Scotland were examined for occurrence and availability of several nutrients.

D78-36 (continued)

Phosphorus, potassium, calcium, magnesium and sodium were determined on 0.5 M acetic acid extracts of the refuse samples, and nitrogen was determined by the Kjeldahl method. Ryegrass grown on refuse in pots showed that nitrogen was deficient on all sites; potassium and calcium, but not magnesium and sodium, were influenced by acid leaching and ignition; and the behavior of phosphorus is complex. Jour, D250a

D78-37 A QUALITATIVE ASSESSMENT OF POTENTIAL ACIDITY IN COAL MINE WASTE

Pulford, I. D. and Duncan, H. J., Reclamation Review 1 (2), 51-54 (1978). The several sampling sites in Scotland ranged in age from an active colliery with fresh refuse to a long-abandoned site having good vegetation. The sites were classified according to the pH of the refuse and the amount of acetic acid extractable sulfate. Low sulfate was found to be characteristic of new sites and high sulfate of older sites, while pH progressed from a higher level on new sites to a lower, or acid, level on sites of median age and back to higher levels on older sites. Jour, D250

D78-38 DISPOSAL OF COLLIERY TAILINGS BY FLUIDISED BED COMBUSTION

Randell, A. A., Gauld, D. W., Dando, R. L., and LaNauze, R. D. (National Coal Board, Great Britain), in "Proceedings of the Second Engineering Foundation Conference," Trinity College, Cambridge, England, April 2-6, 1978, J. F. Davidson and D. L. Keairns, Eds., London, England: Cambridge University Press, 1978. pp 286-291. This paper outlines the process, describes the one tonne per hour pilot plant, and discusses plant control. In the process, fine refuse slurry is sprayed onto the top of a fluidised bed. The water content of the tailings is evaporated by heat produced from combustion of the coal component and leaves the combustor as part of the flue gas. Two principal ash products are produced, a granulated coarse bed ash and fine cyclone dusts. A summary of data obtained during some of the commissioning tests is given. Essential to stable plant operation is control of the mean bed particle size, methods of achieving this are described. (From authors' abstract) 660 F25

D78-39 COST ANALYSIS OF TRANSPORTATION SYSTEMS FOR COAL REFUSE DISPOSAL

Roberts, J. M. (Ackenheil & Associates Geo Systems, Inc.), Mining Congress Journal 64 (7), 53-58 (July 1978). Two case studies are presented. One illustrates the factors involved in site selection and the other, the costs which would be incurred by six different systems for transporting refuse to a given site. The transportation systems were also evaluated for eight qualitative factors such as all-weather capability, probable reliability, and environmental disturbance. Jour

D78-40 COAL WASTE DISPOSAL AT NATIONAL POCAHONTAS MINE

Roberts, J. R. and Geisler, H. J., Mining Congress Journal 64 (12), 39-43 (Dec. 1978). The original waste disposal area, used from 1969 to 1972, is described. In reactivating the area in 1975, it was necessary to comply with Federal and state regulations which had come into effect. Under these

D78-40 (continued)

regulations, the refuse disposal area was defined as an impoundment. As such, the numerous requirements which it had to meet are listed. The determination of the stability of the original structure is described. Also described is the design of the expansion of the refuse area in which provision was made for drainage of subsurface water through the disposal area to prevent buildup of pressure which could cause failure of the structure. Jour, D370

D78-41 APPLICATION OF VIBRATING EQUIPMENT FOR STORAGE AND HANDLING OF COAL FILTER CAKE AND REFUSE

Roessler, M. L. (Vibranetics, Inc.), in "Proceedings Fourth Kentucky Coal Refuse Disposal and Utilization Seminar," Pine Mountain State Park, Pineville, Kentucky, by University of Kentucky, Pikeville College, and Harlan County Coal Operators Association, June 6-7, 1978, J. G. Rose and R. W. De Vore, Eds., Institute for Mining and Minerals Research, IMMR40-RRR5-78 (Dec. 1978). pp 57-63. Available, ORES Publications, College of Engineering, University of Kentucky, Lexington, Kentucky 40506 The use of vibrating equipment in discharging normal refuse, filter cake, and a mixture of refuse and filter cake from storage bins is described. 631 K3, CE844g

D78-42 HANDLING PREP PLANT REFUSE WITH VIBRATING EQUIPMENT

Roessler, M. L. (Vibranetics, Inc., Louisville, Kentucky), Coal Mining & Processing 15 (9), 100-102, 104 (Sept. 1978). Problems of handling refuse depend on the particle size and moisture content of refuse, with the refuse which is most difficult to handle characterized by higher moisture content and higher percentage of fines. General problems of materials handling are reviewed and the advantages and disadvantages of electro-magnetic and electro-mechanical feeders are discussed. Jour

D78-43 SINTERED COAL REFUSE LIGHTWEIGHT MASONRY AGGREGATE

Rose, J. G. (University of Kentucky), "Proceedings of the North American Masonry Conference," University of Colorado, Boulder, Colorado, Aug. 1978. pp 8-1 - 8-29. Bituminous coal refuse, a waste product obtained from five coal preparation plants in Kentucky, was successfully sintered on a traveling grate to produce lightweight construction aggregate. Brief discussions are presented on the origin of coal refuse and of the aggregate processing operation. Detailed descriptions are given of laboratory evaluations of the sintered aggregate to determine its suitability for use in manufactured concrete masonry products. Standard-size concrete blocks were fabricated using the sintered aggregate for purposes of ascertaining strength, durability, weight and heat conductivity properties. Results were compared with similarly-produced limestone control blocks. Test parameters were determined to be satisfactory. Also described are advantages of lightweight aggregate and resultant benefits derivable from using coal refuse as a raw material for sintered lightweight aggregate production. (From author's abstract) CE923

D78-44 USE OF AN IMPROVED CONTINUOUS SINTERING GRATE FOR LIGHTWEIGHT AGGREGATE PRODUCTION FROM BITUMINOUS COAL REFUSE

Rose, J. G. and Stewart, O. W. (University of Kentucky), in Proceedings of the Institute for Briquetting and Agglomeration, 15th Biennial Conference, Montreal, Quebec, Aug. 1977 (Published 1978). pp 41-56. Available, Executive Director, W. W. Eichenberger, Erie Briquetting Co., P. O. Box 794, Erie, PA 16512. The studies at the University of Kentucky, Institute for Mining and Minerals Research, carried out over several years to explore the feasibility of producing lightweight aggregate from coal refuse are reviewed. The aggregate was found to be suitable for use in structural products and in skid-resistant pavement. One economic advantage in the use of refuse to produce lightweight aggregate is that the fuel value of the raw refuse can provide the greater part of fuel requirements of the process. IBA

D78-45 UTILIZATION OF INDUSTRIAL WASTE: FLUIDIZED-BED FIRING OF WASHERY WASTES

Rubin, Yu. M. and Gavrik, M. V., Coke and Chemistry USSR (UkrNIIugleobogashchenie) 5, 69-71 (1978). Coal cleaning refuse was prepared for further use by heating in a fluidized bed. The work gave information on fluidization velocity and temperature conditions throughout the bed necessary for maximum removal of combustible material. Problems were encountered in removing sulfur oxides from gaseous effluent of the process, and it was recommended that sulfur content of feed be kept below two percent. Heat recovery was suggested to improve the economics of the process. CE933

D78-46 COMPUTERIZED SLOPE STABILITY ANALYSIS OF REFUSE PILES AND IMPOUNDMENTS BY THE SIMPLIFIED BISHOP METHOD

Sawyer, S. G., Mazzei, D. S., and Wu, K. K. (Technical Support Center, Pittsburgh, Pennsylvania), U.S. Department of Interior, Mining Enforcement and Safety Administration, Informational Report 1068 (1978). 87 pp. This report presents the steps involved in computer-modeling and analyzing refuse piles and impoundments via the Simplified Bishop Method of Slices, a commonly employed technique for circular arc failures. Two example problems which use the well-known computer program entitled SBM (Simplified Bishop Method), which was originally developed at Massachusetts Institute of Technology, are given. A listing and description of, and input cards for the SBM program are presented in the appendices. (From authors' abstract) MESA, CE404

D78-47 MONITORING THE EFFECTS OF COAL REFUSE DISPOSAL AND RECLAMATION ON WATER QUALITY IN SOUTHWESTERN ILLINOIS

Schubert, J. P., Olsen, R. D., and Zellmer, S. D. (Argonne National Laboratory), Proceedings, 4th Joint Conference on Sensing of Environmental Pollutants, New Orleans, Louisiana, Nov. 6-11, 1977, Washington, D.C.: American Chemical Society, 1978. pp 724-731. The effects of drainage from an abandoned coal refuse disposal area near Staunton, Macoupin County, Illinois, were monitored in 1975 and 1976. Results of analyses of samples taken at different flow rates from refuse area discharge, at confluence of discharge with Cahokia Creek, and at a point midway between discharge and confluence are

D78-47 (continued)

tabulated, as are results of analyses of samples from monitoring wells in shallow ground water and from residential wells. During high flow, significant acidity, dissolved metals, and sulfate were transported to Cahokia Creek, while during low flow, much lower concentrations of acidity and dissolved material were transported. Although the shallow ground water wells, particularly within about 400 feet of the refuse pile, showed effects of leachate, it did not appear to have affected the residential wells. CE906

D78-48 DEWATERING TAILINGS WITH A CONTINUOUS BELT PRESS

Singh, B. K. and Erdmann, W., Glückauf + Translation 114 (7), 169-170 (April 6, 1978). This equipment was tested and found to produce an acceptable low moisture, compact cake suitable for use as fuel for fluidized-bed combustion. The continuous belt press technique is comprised of three stages: 1) the conditioning of the slurry with the flocculant, 2) a preliminary dewatering by separating the free water in the percolator section, and 3) a second dewatering in the shearing, milling and compressing stages. The performance of various flocculants was tested in the laboratory to select the type that would form the most stable floc, yield the most water, not be destroyed during compression and dewatering stages, and not flow out sideways from the two belts. Jour

D78-49 REVEGETATION OF ANTHRACITE REFUSE BANKS TREATED WITH MUNICIPAL SEWAGE EFFLUENT AND SLUDGE: PHASE II

Sopper, W. E., Kardos, L. T., and Kerr, S. N., The Pennsylvania State University, Institute for Research on Land and Water Resources, Research Project Technical Completion Report to U.S. Bureau of Mines, Project Number: G0166049, March 1978. 80 pp. NTIS, PB-283 394/5WN. The Cedar Avenue refuse bank, Scranton, Pennsylvania, where an underground mine and refuse fire had been extinguished several years previously, was the site of this study. Sewage sludge from the local treatment plant was applied at three different levels, with control plots receiving no application. Survival and growth of ten species of tree seedlings, five species of grasses and five of legumes were monitored from 1974 through 1976. Leachate samples from the plots were collected and analyzed during the first and third growing seasons. Among the conclusions of the study are: (1) Tree seedling survival was higher at the lower sludge application rates. However, the higher sludge application rates produced the greatest height growth. (2) The hardwood tree species were superior to the conifers in terms of survival and growth responses. (3) Reed canarygrass, tall fescue, and orchardgrass had the best growth response of the grasses tested; and birdsfoot trefoil and Penngift crownvetch were the best of the legumes tested. (4) The sludge applications increased the uptake of nitrogen and heavy metals in the vegetation. No heavy metal toxic effects were observed on any vegetation. (5) The 150 T/ha sludge application rate produced the best overall herbaceous vegetation growth response. The 40 and 75 T/ha sludge application rates produced the best tree seedling growth response. (6) By the third growing season, water quality was not impaired due to the sludge application. Zinc and cadmium concentrations in the leachate were lower in the sludge-treated plots than in the control plots.

D78-49 (continued)

Only one of the 150 T/ha sludge plots had leachate nitrate-nitrogen concentration values above 10 mg/l. This study showed that burned anthracite refuse banks may be revegetated successfully using heat-dried sewage sludge as an organic amendment and fertilizer. (Adapted from authors' Introduction and Conclusions) CE597

D78-50 BENEFICIATION OF COAL SLURRY

Stirling, H. T. (Stirling Processing Company), in Proceedings of the Institute for Briquetting and Agglomeration, 15th Biennial Conference, Montreal, Quebec, Aug. 1977 (Published 1978). pp 27-40. Available, Executive Director, W. W. Eichenberger, Erie Briquetting Co., P. O. Box 794, Erie, PA 16512. The process of recovering and pelletizing coal fines, usually discarded as a slurry from coal preparation plants, is discussed. IBA

D78-51 TRACE ELEMENT CHARACTERIZATION OF COAL WASTES--FIRST ANNUAL REPORT, JULY 1, 1975 TO JUNE 30, 1976

Wewerka, E. M. and Williams, J. M., Los Alamos Scientific Laboratory, Interagency Energy-Environment Research and Development Program Report to U.S. EPA, Office of Research and Development, and U.S. Department of Energy, Division of Environmental Control Technology, EPA-600/7-78-028, LA-6835-PR (March 1978). 52 pp. A summary of the conclusions drawn from the literature study is included in the Appendix. Techniques and methods for analyzing trace elements and minerals in coals and coal cleaning wastes have been developed and are documented in this report. Standard coal and ash samples were used to establish the precision and accuracy of these methods. High-sulfur coal-waste materials have been collected from three coal cleaning plants in the Illinois Basin, and cleaning wastes from a low-sulfur coal have also been collected. Results of initial studies of occurrence of trace elements in coal refuse and of conveyance of trace elements during weathering and leaching are also included. (Adapted from authors' abstract) DOE, CE634

D78-52 TRACE ELEMENT CHARACTERIZATION OF COAL WASTES - SECOND ANNUAL PROGRESS REPORT, OCTOBER 1, 1976 - SEPTEMBER 30, 1977

Wewerka, E. M., Williams, J. M., Vanderborgh, N. E., Harmon, A. W., Wagner, P., Wanek, P. L., and Olsen, J. D., Los Alamos Scientific Laboratory, Interagency Energy-Environment Research and Development Program Report to U.S. EPA, Office of Research and Development, and U.S. Department of Energy, Division of Environmental Control Technology, EPA-600/7-78-028a, LA-7360-PR (July 1978). 144 pp. The completed analyses of the trace elements and major minerals in bulk refuse and coal samples from the Illinois Basin are included in this report, as are results of studies to elucidate the structural relationships and associations among the trace elements in these materials. Several series of weathering and leaching experiments resulted in the identification of the trace elements of most environmental concern in typical Illinois Basin refuse and coal. Initial work toward recommending pollution-control technology is also reported. EPA, CE635

D78-53 COAL ASSOCIATED MATERIALS AS POTENTIAL NON-BAUXITE SOURCES OF ALUMINA

Winer, A. A. and Tibbetts, T. E., Energy, Mines and Resources Canada, CANMET Report 78-31 (Oct. 1978). 14 pp. This study has shown that coal mine and wash plant rejects from southern Alberta and British Columbia represent a potential source of alumina. The Hat Creek area of British Columbia represents the best potential source of coal-associated alumina both quantitatively and qualitatively. Sufficient information is not available to evaluate the potential of coal-associated shales as a source of alumina. (Adapted from authors' abstract) CANMET

D78-54 PREPARATION HEADACHE: DISPOSAL OF REFUSE FINES

Zimmerman, R. E. (Paul Weir Company), World Coal 4 (4), 14 (April 1978). Research by industry and government on stabilizing fine coal refuse is reviewed. Studies have been carried out on the use of chemical additives, including a fly ash and lime combination which is reported to work better than either fly ash or lime alone. Jour, CE4

1979

D79-1 A PILOT-SCALE TREATMENT OF COAL PREPARATION PLANT EFFLUENT BY THE SELECTIVE AGGLOMERATION PROCESS

Armstrong, L. W., Swanson, A. R., and Nicol, S. K. (Broken Hill Proprietary Co., Ltd., Australia), CIM Bulletin 72 (811), 89-92 (Nov. 1979). The authors describe the oil agglomeration process developed by Broken Hill Proprietary Co., Ltd., for recovery of fine coal from refuse and summarize the results of the operation of the process. Jour

D79-2 IMPROVEMENT OF COAL REFUSE STABILITY

Augenstein, D. A. (1) and Amundson, L. V. (2) [(1) Bethlehem Steel Corp. and (2) Bethlehem Mines Corp.], Society of Mining Engineers of AIME, Fall Meeting, St. Louis, Missouri, Oct. 19-21, 1977. Preprint No. 77-F-309. 14 pp. Also published in Transactions of AIME 266, 1898-1900 (1979). The experimental program described in this paper tested the following methods of improving the load-bearing properties of coal refuse: moisture reduction, addition of crushed coarse refuse, addition of fly ash, addition of lime, and addition of a mixture of lime and fly ash. In terms of a balance between economic and technical considerations, the most effective method was demonstrated by laboratory and plant tests to be a 2 to 5% addition of lime. (From authors' Introduction) Jour, SME

D79-3 FLUIDIZED-BED COMBUSTION OF FLOTATION TAILINGS

Belting, K. W. (Babcock-BSH A.-G., West Germany), World Coal 5 (6), 30-33 (June 1979). The fluidized-bed combustion of dewatered refuse from flotation cleaning of coal is shown to be able to be sustained without the introduction of additional fuel. The addition of limestone to the bed material can control the sulfur dioxide content of the exhaust gas. The use of combustion residues in building materials is described. Jour

D79-4 THE MAIN TRENDS OF WORKS ON ENVIRONMENTAL PROTECTION AGAINST THE INFLUENCE OF COAL-PREPARATION PLANTS IN THE USSR

Blagov, I. S., Vosnyuk, G. G., Kochetov, V. V., Nekhoroshy, I. Ch., and Cherevko, I. E. (USSR Ministry of Coal Industry), in "Proceedings: Symposium on Coal Cleaning to Achieve Energy and Environmental Goals (September 1978, Hollywood, FL)," Volume I, S. E. Rogers and A. W. Lemmon, Jr., Eds., Battelle Columbus Laboratories, Interagency Energy-Environment Research and Development Program Report to U.S. EPA, Industrial Environmental Research Laboratory, Research Triangle Park, North Carolina, EPA-600/7-79-098a (April 1979). pp 207-227. This extensive review of coal preparation activity in Russia includes information on the characterization of refuse from various coal mining areas, particularly sulfur content, on refuse disposal, and on the use of refuse in construction materials, and in land and roadway development. EPA

D79-5 PRELIMINARY ASSESSMENT OF THE SECONDARY ENERGY RECOVERY POTENTIAL OF KENTUCKY COAL REFUSE: I. RESOURCE CHARACTERIZATION. II. COMBUSTION OF A FINES SLURRY

Bland, A. E., Robl, T. L., Strange, W. T., and Wesley, D. P. (University of Kentucky), preprint from Proceedings, 5th Kentucky Coal Processing Plant Refuse Utilization and Disposal Symposium, Pineville, Kentucky, by University of Kentucky, Institute for Mining and Minerals Research, IMMR-79D13-TR13 (May 1979). (40 pp.) The paper describes the extent of the problem of refuse disposal in Kentucky and the use of atmospheric fluidized-bed combustion (AFBC) to recover the heat value of the refuse. Disposal of AFBC residue is shown to have minimal environmental impact. Various uses for the residue are also discussed. CE828

D79-6 CHARACTERIZATION OF SOLID CONSTITUENTS IN BLACKWATER EFFLUENTS FROM COAL PREPARATION PLANTS

Bradley, P. B., Aplan, F. F., and Hogg, R., Pennsylvania State University, Interagency Energy-Environment Research and Development Program Report to U.S. EPA, Industrial Environmental Research Laboratory, Research Triangle Park, North Carolina, and U.S. Department of Energy, Division of Solid Fuel Mining and Preparation, Pittsburgh, Pennsylvania, EPA-600/7-79-006 and FE-9002-1 (Jan. 1979). 189 pp. The report gives results of a characterization of the fine solid constituents of coal preparation plant waste water, to provide a better understanding of how to treat the water for recycle or discharge. Thirteen waste water samples, obtained from coal preparation plants throughout the U.S., were analyzed for: identification and quantification of solid constituents, size analysis of solids, and surface properties of the solids. The study concluded that: (1) Eastern and Western coal region samples can be distinguished on the basis of mineralogy and size distribution of the solid particles; (2) the carbonaceous material of Eastern coals averages 60% of the blackwater solids, and the remaining 40% consists of clay minerals, quartz, calcite, and pyrite; and (3) virtually all of the carbonaceous material in Eastern plant waste waters can be removed by froth flotation, with the product containing 11% mineral matter. (Authors' abstract) EPA, CE154

D79-7 RECOVERING FINE-SIZE COAL FROM ALABAMA WASHER WASTES USING HUMPHREYS SPIRAL

Browning, J. S. (Alabama Mineral Resources Institute), Society of Mining Engineers of AIME, Fall Meeting, St. Louis, Missouri, Oct. 19-21, 1977. Preprint No. 77-B-318. 17 pp. Also published in Transactions of AIME 266, 1824-1828 (1979). Batch laboratory and continuous tests of nine surface-mine washer-reject samples were run in the Humphreys spiral. The tests demonstrate the technical feasibility of processing high-ash coal-waste fines to recover high quality clean coal products which meet or exceed specifications for commercial grade coal in Btu value, and ash and sulfur content. (From author's abstract) Jour, SME

D79-8 EVALUATION OF CURRENT FINE-SIZE WASTES FROM ALABAMA COAL PREPARATION PLANTS

Browning, J. S. and Bush, J., Alabama Mineral Resources Institute and State Mine Experiment Station, MRI Technical Report Series, T. R. Number 7 (1979). 29 pp. The Mineral Resources Institute and State Mine Experiment Station of The University of Alabama sampled the current washer waste from twenty-three Alabama coal preparation plants to determine the approximate quantity of waste and the amount of recoverable coal based on washability tests of representative samples of the waste. The data assembled from the sampling indicate that 1,714,000 tons of fine-size waste are being discarded each year, of which 568,180 tons are recoverable coal of high quality. (From authors' abstract) Ala

D79-9 DESIGN OF COAL SLURRY IMPOUNDMENTS AND THE IMPACT OF MESA LEGISLATION

Brumund, W. F. (1) and Murray, J. R. (2) [(1) Golder Associates, Inc. and (2) Consolidation Coal Company], in "Stability in Coal Mining," Proceedings of the first International Symposium, Vancouver, British Columbia, Canada, 1978, C. O. Brawner and I. P. F. Dorling, Eds., San Francisco: Miller Freeman Publications, 1979. pp 376-380. This chapter briefly reviews some of the types, uses, design considerations, and construction techniques for surface impoundments used in the surface bituminous coal industry in Illinois. Special emphasis is given to the geotechnical aspects of the design of slurry impoundments. The impact that the Mining Enforcement and Safety Administration legislation has had on the design and construction of these impoundments is reviewed. (Authors' Introduction) 622 S77

D79-10 WATER CLARIFICATION USING THE HYDRA-RAKE SYSTEM

Burdette, J. M. (Consolidation Coal Company), AIME Annual Meeting, Coal Division Mini Symposium, Refuse Disposal from Coal Operations, New Orleans, Louisiana, Feb. 1979, Mini Symposium Series No. 79-03. pp 21-22. Available, Society of Mining Engineers of AIME, Caller No. D, Littleton, CO 80123, $4.00 The use of the Hydra-Rake system at Consol's Champion Preparation Plant is described. AIME

D79-11 COKE RECLAIMING PAYS OFF

Burger, J. R., Coal Age 84 (11), 114-120 (Nov. 1979). Coal, as well as coke, is reclaimed from refuse left from a mining and coking operation in Fayette County, Pennsylvania, active from about the turn of the century to the late 1940's. The cleaning plant built for Pittsburgh Coal & Coke, Inc., and its operation in producing either coal or coke are described. Jour

D79-12 PERFORMANCE OF A WASTE ROCK DUMP ON MODERATE TO STEEPLY SLOPING FOUNDATIONS

Campbell, D. B. (1) and Shaw, W. H. (2) [(1) Golder Associates, Ltd. and (2) Fording Coal Limited], in "Stability in Coal Mining," Proceedings of the first International Symposium, Vancouver, British Columbia, Canada, 1978, C. O. Brawner and I. P. F. Dorling, Eds., San Francisco: Miller Freeman Publications, 1979. pp 395-405. The Clode refuse disposal area at Fording Coal operations in Canada is considered typical of a refuse dump on a moderate to steeply sloping foundation. Because dumping takes place at the crest of the pile, particle sizes are segregated naturally as the refuse rolls down the slope, with the most coarse material forming the toe. This coarse material at the base forms a drainage layer as it is covered with finer material as the refuse pile face advances. This, with the fact that surface runoff is diverted from the refuse dumping area, contributes to the stability of the pile. However, various movements and modes of failure of the crest and face of the refuse pile have been observed and are described. Refuse handling and dumping procedures are suggested to minimize these slope movements. 622 S77

D79-13 THE ART OF USING VACUUM DISC FILTERS TO CLOSE PLANT WATER CIRCUITS

Carris, D. M. and Shaw, J. P. (Eastern Associated Coal Corporation), AIME Annual Meeting, Coal Division Mini Symposium, Refuse Disposal from Coal Operations, New Orleans, Louisiana, Feb. 1979, Mini Symposium Series No. 79-03. pp 1-3. Available, Society of Mining Engineers of AIME, Caller No. D, Littleton, CO 80123, $4.00 Eastern Associated Coal Corporation installed a vacuum disc filter system at its Kopperston, West Virginia, plant to eliminate the tailings pond and reduce the amount of plant make-up water. It was recognized that the plant static thickener tailings would be a very difficult slurry to dewater because of its unusually high clay content. The paper gives a case history of the Kopperston installation and the refinements made in its vacuum disc filter operation to increase efficiency. One of the conclusions was that chemical flocculation was essential for removal of the finest particles. (Adapted from authors' Introduction and Conclusions) AIME

D79-14 ENGINEERING PROPERTIES OF COAL MINE REFUSE

Chen, C. Y. (Michael Baker, Jr., Inc.), in "Stability in Coal Mining," Proceedings of the first International Symposium, Vancouver, British Columbia, Canada, 1978, C. O. Brawner and I. P. F. Dorling, Eds., San Francisco: Miller Freeman Publications, 1979. pp 328-347. This paper discusses engineering properties affecting three unique properties of coal refuse:

D79-14 (continued)

degradation, combustion, and acid generation potential. The discussion is based on analyses of data collected from the United Kingdom and the United States. (Adapted from author's Introduction) 622 S77

D79-15 AGGLOMERATION OF COAL FINES

Clayfield, E. J., Pinnington, C., Cannon, M. J., and Sant, P. (to Shell Oil Company), U.S. Patent 4,153,419 (May 8, 1979). 4 pp. The claims covered by this patent include the use of oil for agglomeration of coal from a slurry which has a high ash content such as would be the case with coal refuse. US Pat, CE928

D79-16 ABUNDANCE AND RECOVERY OF SPHALERITE AND FINE COAL FROM MINE WASTE IN ILLINOIS

Cobb, J. C., Masters, J. M., Treworgy, C. G., and Helfinstine, R. J., Illinois State Geological Survey, Illinois Minerals Note 71 (March 1979). 11 pp. A million tons of marketable coal and 1100 tons of zinc are estimated to be present in a coal mine refuse deposit in west-central Illinois. In the 45 acres covered by the fan-shaped slurry deposit, the coal content was found to increase radially outward from the discharge pipe toward the settling pond, while the zinc content decreased. The maximum coal content was found 600 feet from the discharge pipe. The bulk of the zinc occurs in a 450-foot radius from the discharge pipe. (From authors' abstract) D93

D79-17 COLLIERY WASTE LANDSCAPING COMMENDED BY CIVIC TRUST

Surveyor 153 (4530), 16 (April 1979). Land reclamation in Lancashire, including the regrading and planting of a coal refuse disposal area, is described. CE964

D79-18 ABANDONMENT OF A COAL SLUDGE POND: STABILITY CONSIDERATIONS

Curran, J. W. (1) and Roberts, J. M. (2) [(1) The Pittston Company and (2) Ackenheil & Associates Geo Systems, Inc.], AIME Annual Meeting, Coal Division Mini Symposium, Refuse Disposal from Coal Operations, New Orleans, Louisiana, Feb. 1979, Mini Symposium Series No. 79-03. pp 13-19. Available, Society of Mining Engineers of AIME, Caller No. D, Littleton, CO 80123, $4.00 This paper presents a case study in which a sludge pond was abandoned by covering it with coarse refuse. Initially, stability analyses were performed for existing and proposed embankment configurations to allow temporary continued use of the pond. Methods of analysis and strength parameters obtained during the investigative phase are presented. Subsequently, extensive analysis was performed to demonstrate that the sludge pond could be covered with up to 195 ft. of coarse coal refuse without exceeding allowable safety factors. The M.I.T. computer package, ICES-SEPOL, was used to calculate excess pore pressure at various depths and at various times during the proposed loading of the pond area. Small bearing capacity type failures during initial covering

D79-18 (continued)

of the pond are also discussed. A brief discussion of equipment operator attitudes during the initial covering on the pond indicates a need for having a field representative at the site during this period. (Authors' abstract) AIME

D79-19 DERELICT LAND REVITALISED

Surveyor 153 (4544), 8-9 (July 12, 1979). Among the projects awarded prizes for reclamation in Great Britain were several which were carried out on abandoned coal refuse disposal areas. CE953

D79-20 DESIGN GUIDELINES FOR COAL REFUSE PILES AND WATER, SEDIMENT, OR SLURRY IMPOUNDMENTS AND IMPOUNDING STRUCTURES

U.S. Department of Labor, Mine Safety and Health Administration, Informational Report IR 1109 (1979). 29 pp. This publication presents the guidelines used by the Mine Waste Branches of the Mine Safety and Health Administration's Denver Technical Support and Pittsburgh Technical Support Centers and by MSHA district managers in their review of engineering plans for coal refuse impoundments. These guidelines give detailed information on the hydrologic, hydraulic, and geotechnical factors that should be considered in planning such structures. A plan review checklist is included. (Authors' abstract) CE195

D79-21 CRITERIA FOR ASSESSMENT OF ENVIRONMENTAL POLLUTANTS FROM COAL CLEANING PROCESSES

Ewing, R. A., Cornaby, B. W., Van Voris, P., Zuck, J. C., Raines, G. E., and Min S., Battelle Columbus Laboratories, Interagency Energy-Environment Research and Development Program Report to U.S. EPA, Industrial Environmental Research Laboratory, Research Triangle Park, North Carolina, EPA-600/7-79-140 (June 1979). 189 pp. Fifty-one elements and 23 substances or groups of substances were selected for investigation, the results of which showed that there are large gaps in data for many elements and many species. Illustrative data on ecological transport and distribution are presented for arsenic, beryllium, cadmium, iron, lead, manganese, mercury, and selenium. Twenty formulae for deriving estimated permissible concentrations (EPC's) were identified and considered in this study. No one formula was found to fulfill all needs; recommendations were developed for suggested improvements. A major deficiency in all formulae is the inability to utilize the variety of pertinent toxicological data available. Improved methods are needed for interconversion of toxicological data to more useable forms. Equations have been developed for conversion of toxicological data for four non-oral routes of administration to an LD_{50} basis. This preliminary investigation has shown that the problem of an adequate health and toxicological effects data base equals or exceeds the methodology problem. One of the most critical information needs to support the derivation of EPC's are dose-response data on the health and ecological effects of individual pollutants and their mixtures. Data are sparse on the pollutants of concern to coal cleaning, and much more research needs to be done in this area. (Adapted from authors' abstract) EPA, CE847

D79-22 STABILIZATION OF COAL WASTE DEPOSITS

Fujimoto, R. I. (U.S. Department of Labor, Mine Safety and Health Administration), in "Stability in Coal Mining," Proceedings of the first International Symposium, Vancouver, British Columbia, Canada, 1978, C. O. Brawner and I. P. F. Dorling, Eds., San Francisco: Miller Freeman Publications, 1979. pp 321-327. The author describes coal waste disposal practices over the years and points out that not only did the quantity of refuse increase with the increase in mechanization of mining, but also that the development of coal waste dams and slurry ponds occurred in response to legislative requirements for prompt compliance with the early water pollution control laws. The author also discusses the failure of the refuse dam at Buffalo Creek, West Virginia, as the cause of the initiation of regulations for design and operation of coal refuse slurry impoundments. 622 S77

D79-23 FEASIBILITY OF ALTERNATIVES FOR SURFACE UTILIZATION OF COAL WASTES

Gushue, J., Fischer, S., and Walker, J., Energy Resources Co. Inc., Final Technical Report as of July 29, 1979 to U.S. Department of Energy, Division of Fossil Fuel Extraction, FE/3105-1 (July 1979). 279 pp. The feasibility of using coarse coal refuse in combination with power plant fly ash to form subbase course material for roadway construction is evaluated for the Monongalia County region in northern West Virginia. On the basis of technical, environmental and economic factors, it is concluded that using coal refuse/fly ash material for roadway subbase construction is feasible in the study area. The key technical and environmental considerations are related to the compaction characteristics of the material. Chemical and physical testing of the material to establish properties, in-place performance, and optimum refuse/fly ash blends followed by proper mixing, handling and compaction during construction will result in a strong, environmentally benign subbase course. The costs of subbase construction with refuse/fly ash were compared with the costs of construction with conventional materials and showed that a 20-mile haul for refuse/fly ash could compete favorably with a 5-mile haul for conventional materials. Lower materials costs for refuse/fly ash more than offset higher handling and mixing costs. The appendixes cover information on environmental impacts of surface disposal of refuse, coal refuse utilization, properties of coal refuse, and amounts of refuse to be generated in eastern and midwestern coal fields through 1985. An annotated bibliography is included. (Authors' abstract adapted) DOE

D79-24 FLOCCULATION OF FROTH FLOTATION TAILINGS FROM A COAL WASHERY

Hamza, H. A., CIM Bulletin 72 (802), 116-121 (Feb. 1979). Three hundred and ninety commercially available flocculants were screened and eight were chosen for laboratory tests of their suitability for settling coal washery slurry. The slurry was obtained from the flotation section of the washery of Cardinal River Coals Ltd., Luscar, Alberta, Canada. A Cost Performance Index, related for this study to the optimum dosage, was determined for each flocculant and used to identify the material giving the best results. A study of flocculant aids was also carried out. Jour, CE689

D79-25 COAL PREPARATION PROJECTS IN THE UK

Hillman, J. (Birtley Engineering Limited, England), Mining Engineering 31 (11), 1602-1608 (Nov. 1979). Discussed in this article are the use of froth flotation to separate fine refuse and coal in order to control the ash content of fine coal used in fuel blends for power plants and the treatment and disposal of thickened refuse from flotation plants. Jour

D79-26 STABILIZATION OF COAL PREPARATION PLANT SLUDGES

Hoffman, D. C., in "Proceedings: Symposium on Coal Cleaning to Achieve Energy and Environmental Goals (September 1978, Hollywood, FL)," Volume II, S. E. Rogers and A. W. Lemmon, Jr., Eds., Battelle Columbus Laboratories, Interagency Energy-Environment Research and Development Program Report to U.S. EPA, Industrial Environmental Research Laboratory, Research Triangle Park, North Carolina, EPA-600/7-79-098b (April 1979). pp 875-897. The paper briefly reviews Calcilox additive stabilization techniques, presents the latest technical developments, and illustrates Calcilox additive disposal alternatives that can technically and economically improve fine coal refuse disposal. (Adapted from author's abstract) EPA

D79-27 MANAGEMENT OF COAL PREPARATION FINE WASTES WITHOUT DISPOSAL PONDS

Hoffman, D. C., Briggs, R. W., and Michalski, S. R., Dravo Corporation, Interagency Energy-Environment Research and Development Program Report to U.S. EPA, Industrial Environmental Research Laboratory, Research Triangle Park, North Carolina, and U.S. Department of Energy, Division of Solid Fuel Mining and Preparation, Pittsburgh, Pennsylvania, EPA-600/7-79-007 and FE-11270-1 (Jan. 1979). 43 pp.+ The objective of this study is to ascertain some physical/chemical properties of a diverse sampling of fine coal refuse and to investigate the effect of chemical stabilization. Samples of fine coal refuse were obtained from some of the major coal seams in the Eastern bituminous coal fields. Two common and one proprietary chemicals were employed in testing chemical stabilization on nine samples of fine coal refuse. This study indicated that chemical stabilization can be employed to drastically improve some physical/chemical properties of the fine refuse for better handling and disposal. The proprietary chemical, Calcilox© additive, is the most effective over the range of samples tested. Portland Type I cement is also effective but greatly influenced by waste solids concentration. The final chemical tested, lime, is inferior to the other two chemicals and generally ineffective in improving the fine waste's physical/chemical properties. (From authors' abstract) EPA, DOE, CE726

D79-28 A TECHNICAL AND ECONOMIC OVERVIEW OF COAL CLEANING

Huettenhain, H., Yu, J., and Wong, S. (Bechtel National, Inc.), in "Proceedings: Symposium on Coal Cleaning to Achieve Energy and Environmental Goals (September 1978, Hollywood, FL)," Volume I, S. E. Rogers and A. W. Lemmon, Jr., Eds., Battelle Columbus Laboratories, Interagency Energy-Environment Research and Development Program Report to U.S. EPA,

D79-28 (continued)

Industrial Environmental Research Laboratory, Research Triangle Park, North Carolina, EPA-600/7-79-098a (April 1979). pp 256-297. Cost of coal refuse disposal is one of the factors considered in this study. EPA

D79-29 COMPARISON OF LIME AND FLY ASH AS AMENDMENTS TO ACIDIC COAL MINE REFUSE: GROWTH RESPONSES AND TRACE-ELEMENT UPTAKE OF TWO GRASSES

Jastrow, J. D., Zimmerman, C. A., Dvorak, A. J., and Hinchman, R. R., Argonne National Laboratory, Land Reclamation Program, Report to U.S. Department of Energy, ANL/LRP-6 (Oct. 1979). 36 pp. "Kentucky 31" tall fescue and "Lincoln" smooth brome were grown for 60 days in pots containing coarse coal mine refuse from Illinois, with either lime or alkaline fly ash amendments, and in pots containing silt-loam surface soil as controls. Morphological growth parameters were measured over time; dry weights and shoot:root ratios were determined at harvest. Concentrations of Al, As, Cd, Co, Cr, Cu, Fe, Hg, Mn, Ni, Pb, Se, V, and Zn in the plant shoots were determined by atomic absorption spectrophotometry. Plant growth of both species was not as good on either lime- or fly ash-amended gob as it was on surface soil. Although plant height and length of the longest leaf were not significantly different for plants grown on the amended refuse, parameters giving an indication of plant vigor (number of leaves and stems, width of longest leaf, and biomass) were significantly greater for plants grown on lime-amended refuse. Significant differences in the tissue concentrations of Cd, Co, Fe, Hg, Mn, Pb, V, and Zn were found among the plants grown on the three substrates. Except for Hg and Pb, these elements were higher in plants grown on at least one of the amended refuse substrates than in plants grown on surface soil. Significant substrate differences were not observed for Al, As, Cr, Cu, Ni, and Se. The tissue concentrations of some elements -- notably Al, Cu, Fe, Mn, V, and Zn -- were high enough in plants from one or more of the substrates to either approach or exceed concentrations that have been reported to be associated with toxic effects in some plant species. (Adapted from authors' abstract) DOE, CE895

D79-30 DESIGN OF COMPLIANT REFUSE DISPOSAL SYSTEMS

Kalchthaler, R. F., Jr. and Palmer, E. C. (D'Appolonia Consulting Engineers, Inc.), in "Coal Conference & Expo V, Papers Presented Before the Symposium on Coal Preparation and Utilization," Louisville, Kentucky, by "Coal Age," Oct. 23-25, 1979. pp 141-153. Available, McGraw-Hill, Inc., Mining Informational Services, 1221 Ave. of the Americas, New York, NY 10020. This paper presents a methodology for the design of refuse disposal systems and specific suggestions for the design of key components for these facilities in compliance with the Office of Surface Mining (OSM) regulations. Regulations referred to in the paper are from the permanent OSM program promulgated on March 13, 1979. It is further noted that the requirements of the regulations may vary from state to state as the states are currently in the process of finalizing their regulatory programs. (From authors' Introduction) 662.6 C652p

D79-31 SEWAGE EFFLUENT AND LIQUID DIGESTED SLUDGE AS AIDS TO REVEGETATION OF STRIP MINE SPOIL AND ANTHRACITE COAL REFUSE BANKS

Kardos, L. T., Sopper, W. E., Edgerton, B. R., and DiLissio, L. E., in "Utilization of Municipal Sewage Effluent and Sludge on Forest and Disturbed Land," Proceedings of a Symposium by The Pennsylvania State University, School of Forest Resources and Institute for Research on Land and Water Resources, W. E. Sopper and S. N. Kerr, Eds., University Park, Pennsylvania: The Pennsylvania State University Press, 1979. pp 315-331. In the studies on anthracite refuse, vegetation was grown in boxes which were filled with refuse over a 6-inch layer of quartz sand and which were fitted with lysimeters at varying depths. Effluent and sludge were applied weekly at specified levels. Production of dry matter of grasses and legumes and survival of tree seedlings were monitored. Measurements were made weekly of the chemical quality of leachate and at the end of the experiment of the chemical properties of the refuse. Sewage treatments were found to significantly decrease the amounts of extractable aluminum, iron, and manganese of the refuse, and increase the pH. It was concluded that sewage effluent and sludge will aid in vegetating refuse and that periodic applications will result in greater growth. 628.2 S712

D79-32 RECLAIMING ANTHRACITE REFUSE BANKS WITH HEAT-DRIED SEWAGE SLUDGE

Kerr, S. N., Sopper, W. E., and Edgerton, B. R., in "Utilization of Municipal Sewage Effluent and Sludge on Forest and Disturbed Land," Proceedings of a Symposium by The Pennsylvania State University, School of Forest Resources and Institute for Research on Land and Water Resources, W. E. Sopper and S. N. Kerr, Eds., University Park, Pennsylvania: The Pennsylvania State University Press, 1979. pp 333-351. The Cedar Avenue refuse bank in Scranton, Pennsylvania, was treated with heat-dried sludge and sewage effluent from the adjacent Scranton-Danmore Waste Treatment Plant. Legumes, grasses, and trees were planted on the experimental plots which received four rates of sludge application, 0, 40, 75, and 150 dry metric tons per hectare. Refuse was sampled and analyzed before treatments began. Samples of leachate from lysimeters installed in the experimental plots were collected and analyzed during the first and third growing seasons. The authors conclude that "Based on the results of this study, it seems evident that burned anthracite refuse banks may be successfully revegetated using heat-dried sewage sludge as an organic amendment and fertilizer. The addition of treated sewage sludge can be used to ameliorate the harsh site conditions prevalent on the refuse banks without adverse effects on the establishment and survival of vegetation or percolating water quality." 628.2 S712

D79-33 ENVIRONMENTAL ASSESSMENT OF COAL CLEANING PROCESSES: FIRST ANNUAL REPORT; VOLUME I. EXECUTIVE SUMMARY; VOLUME II. DETAILED REPORT

Lemmon, A. W., Jr., Rogers, S. E., Robinson, G. L., Hale, V. Q., and Raines, G. E., Battelle-Columbus Laboratories, Interagency Energy-Environment Research and Development Program Report to U.S. EPA, Industrial Environmental Research Laboratory, Research Triangle Park, North Carolina, Volume I. EPA-600/7-79-073b (June 1979). 64 pp. Volume II. EPA-600/7-79-073c (June 1979). 174 pp. Volume I summarizes the entire program which has the purpose of assessing pollution from transportation, storage, cleaning, and use of

D79-33 (continued)

coal, and from the disposal of coal refuse. In Volume II is a description of the baseline monitoring of the area around the new coal preparation plant of the Homer City, Pennsylvania, power generating plant, and of proposed pollution control methods for refuse disposal. EPA

D79-34 PARTICLE SIZE DISTRIBUTION IN THE LIBERATION OF PYRITE IN COAL

Lovell, H. L. (Pennsylvania State University), in "Proceedings: Symposium on Coal Cleaning to Achieve Energy and Environmental Goals (September 1978, Hollywood, FL)," Volume I, S. E. Rogers and A. W. Lemmon, Jr., Eds., Battelle Columbus Laboratories, Interagency Energy-Environment Research and Development Program Report to U.S. EPA, Industrial Environmental Research Laboratory, Research Triangle Park, North Carolina, EPA-600/7-79-098a (April 1979). pp 91-109. Pyrite liberation is basically dependent upon pyrite particle size, the nature of the pyrite particle occurrence, and the associations of the pyrite particles with other coal components. This paper describes studies designed to provide additional information on these fundamental questions. Laboratory procedures involving selective stage communication, particle sizing, gravity separations, and microscopic examinations are employed to better define the problems and seek pragmatic solutions. Similar concerns apply to the liberation and separation of other coal components (mineral and phytogenic) of concern to coal preparation whether to minimize environmental problems or prepare feedstocks for coal conversion processes. The same relationships are operative in water mineralization from pyrite which creates coal mine drainage problems. The studies are viewed as fundamental to enhanced coal beneficiation and coal industry environmental approaches. (From author's abstract) EPA

D79-35 MAKING FINES PAY

Coal Mining & Processing 16 (9), 96-97 (Sept. 1979). At Burgess Mining and Construction Corporation's Boothton operation, the problem of a high clean coal loss to refuse was handled by adding several hydrocyclones and centrifugal driers to the coal cleaning plant. The operation of the cyclones and driers and the improvement in plant output are described. Jour

D79-36 COAL REFUSE DISPOSAL PRACTICES AND CHALLENGES IN THE UNITED STATES

Martin, J. F. (Industrial Environmental Research Laboratory, U.S. EPA, Cincinnati, Ohio), in "Proceedings of the Second U.S.-Polish Symposium: Coal Surface Mining and Power Production in the Face of Environmental Protection Requirements," Castle Ksiaz, Poland, by U.S. EPA and POLTEGOR, September 26-28, 1979, J. Libicki, Ed., Wroclaw, Poland, Interagency Energy-Environment Research and Development Program Report No. EPA-600/7-79-159 (Oct. 1979). pp 173-190. The potential of pollution from refuse disposal is reviewed. Recent experiences in control of pollution from coal refuse disposal at a number of sites in the United States and at a site in Poland are summarized. EPA

D79-37 RAPCO PLANT MINES REFUSE DUMPS

Mason, R. H., Coal Mining & Processing 16 (4), 108-109, 121 (April 1979). Rapco, Inc., of Kingsport, Tennessee, has designed and built a modular plant, which can be set up quickly, for recovering coal from refuse. Particulate size in the feed is controlled and provides the specific gravity of the slurry for coal separation. The angle and rotational speed of the barrel washer are precisely adjusted for maximum coal product recovery. Reject from the barrel washer is processed through two more washings in cyclones to achieve removal of even the smallest particles of coal. Cyclone underflow is dewatered in a solid bowl centrifuge, with solids going to reject bin or refuse pile and water returned to the system for makeup. Jour, D417

D79-38 USING HUMPHREYS SPIRALS FOR RECOVERY OF MINUS 4 MESH COAL

Mellor, G. H. (Humphreys Engineering Company), in "Coal Conference & Expo V, Papers Presented Before the Symposium on Coal Preparation and Utilization," Louisville, Kentucky, by "Coal Age," Oct. 23-25, 1979. pp 35-41. Available, McGraw-Hill, Inc., Mining Informational Services, 1221 Ave. of the Americas, New York, NY 10020. The paper describes the Humphreys coal spiral and its operation for the recovery of minus 4 mesh fine coal. Examples are given of two 100 tph plants which have incorporated the coal spiral in their flowsheets. A flowsheet is given for recovery of minus 4 mesh fine coal using a Humphreys coal spiral followed by conventional dewatering equipment. (Author's abstract) 662.6 C652p

D79-39 COMBUSTION OF LOW QUALITY COALS IN FLUIDIZED BED STEAM GENERATORS

Mesko, J. E. (Pope, Evans and Robbins Incorporated), in "Coal Conference & Expo V, Papers Presented Before the Symposium on Coal Preparation and Utilization," Louisville, Kentucky, by "Coal Age," Oct. 23-25, 1979. pp 65-74. Available, McGraw-Hill, Inc., Mining Informational Services, 1221 Ave. of the Americas, New York, NY 10020. Early history of this technology is traced, and the progress that has been made in the development of fluidized bed combustion boilers, as well as work currently underway, in the United States and overseas, are reviewed. Details of selected fluidized bed boiler installations are presented, and test results are discussed. Potential application of fluidized bed boilers in industrial plants using peat, anthracite refuse, lignite, and lignite refuse is examined. The impact of proposed new DOE and EPA regulations on solid fuels burning is also examined. (From author's abstract) 662.6 C652p

D79-40 FUEL CONTAMINANTS: VOLUME 4. APPLICATION OF OIL AGGLOMERATION TO COAL WASTES

Mezey, E. J., Min, S., and Folsom, D., Battelle-Columbus Laboratories, Interagency Energy-Environment Research and Development Program Report to U.S. EPA, Industrial Environmental Research Laboratory, Research Triangle Park, North Carolina, EPA-600/7-79-025b (Jan. 1979). 86 pp. This program was undertaken to investigate the feasibility of the oil agglomeration technique for the recovery of coal values from preparation plant wastes and thereby possibly reducing the environmental consequences of coal cleaning-plant

D79-43 OIL AGGLOMERATION FOR FINE COAL REFUSE TREATMENT

Nicol, S. K. (Broken Hill Proprietary Co. Limited, Australia), World Coal 5 (8), 14-16 (Aug. 1979). The development by several companies of the oil-agglomeration method to separate fine coal is reviewed. The Broken Hill Proprietary Company Limited developed an oil-agglomeration process to the semi-commercial stage. The results obtained with this 5-ton-per-hour plant are summarized. The economics of the process are also discussed. Jour

D79-44 USER'S MANUAL: COAL-MINE REFUSE IN HIGHWAY EMBANKMENTS

Pierre, J. J. and Thompson, C. M., L. Robert Kimball & Associates, Consulting Engineers & Architects, Report to U.S. Department of Transportation, Federal Highway Administration, FHWA-TS-80-213 (Dec. 1979). 194 pp. NTIS, PB-80-177538. The Manual covers the use of coarse refuse from mining of both anthracite and bituminous coal. Part I includes information on environmental and economic considerations of refuse disposal and recovery for use, the origin and general physical and chemical characteristics of refuse, and case histories of highway sections constructed from refuse in the United States and in Great Britain. Part II covers procedures for using coal refuse in construction of highway embankments and includes planning and design and sampling methods and testing procedures. An annotated bibliography, divided into seven subject categories, is also included. DOT

D79-45 RECENT ADVANCES IN CANADIAN COAL PREPARATION

Raymond, B. and Payne, B., CIM Bulletin 72 (802), 110-115 (Feb. 1979). The discussion of methods of dewatering fine refuse includes tests of filter presses, use of various types of centrifuges, and drying the refuse to a ten percent total moisture and using it for a power plant fuel. Jour

D79-46 ROAD BUILDING MATERIAL

Civil Engineering, p 60, Sept. 1979. The use of refuse for road base and subbase material is noted. CE941

D79-47 COST ANALYSIS OF TRANSPORTATION SYSTEMS FOR COAL REFUSE DISPOSAL

Roberts, J. M. (Ackenheil & Associates Geo Systems, Inc.), AIME Annual Meeting, Coal Division Mini Symposium, Refuse Disposal from Coal Operations, New Orleans, Louisiana, Feb. 1979, Mini Symposium Series No. 79-03. pp 5-11. Available, Society of Mining Engineers of AIME, Caller No. D, Littleton, CO 80123, $4.00 This paper gives two case studies "which demonstrate the use of economic estimates of transportation cost during preliminary site selection and during the selection of a transportation system for a selected site." AIME

D79-48 STABILITY CONSIDERATIONS DURING ABANDONMENT OF SLUDGE PONDS

Roberts, J. M. (Ackenheil and Associates Geo Systems, Inc.), in "Stability in Coal Mining," Proceedings of the first International Symposium, Vancouver, British Columbia, Canada, 1978, C. O. Brawner and I. P. F. Dorling, Eds., San

D79-48 (continued)

Francisco: Miller Freeman Publications, 1979. pp 413-421. This is a case study of the change from slurry disposal in a pond to a so-called closed system. The purpose of the first part of the study was to evaluate the capacity of the existing pond, which was found to be sufficient for only four months use, and to recommend construction needed for the pond to be used for a total of 12 months. The second purpose of the study was to select a site for disposal of coarse refuse and filter cake reject from the closed system, and design the site for 25 years of use. The economics were favorable for the disposal of refuse over the existing slurry pond. The author describes the laboratory tests and analyses of refuse stability run to evaluate the safety and feasibility of the pond as a long-term disposal site for low-moisture refuse. 622 S77

D79-49 ENVIRONMENTAL ASSESSMENT OF COAL CLEANING PROCESSES: HOMER CITY POWER COMPLEX TESTING

Rogers, S. E., Tolle, D. A., Brown, D. P., Clark, R., Stilwell, J., and Vignon, B. W., Battelle Columbus Laboratories, Interagency Energy-Environment Research and Development Program Report to U.S. EPA, Industrial Environmental Research Laboratory, Research Triangle Park, North Carolina, EPA-600/7-79-073f (Sept. 1979). 257 pp. The refuse disposal site of the Homer City coal cleaning plant is described in detail, with information about the soils, topography, geology and hydrology. The design for water pollution control will permit refuse leachate to be treated at an off-site mine-drainage treatment plant of the Helvetia Coal Company by lime neutralization. Recommendations are made for methods of monitoring the effects of refuse leachate on ground water. EPA

D79-50 ENERGY EFFICIENT SINTERED COAL REFUSE LIGHTWEIGHT AGGREGATE

Rose, J. G. (University of Kentucky), "A Symposium on Energy Savings in Construction," Washington, D.C., Transportation Research Board Fifty-eighth Annual Meeting, Jan. 15-19, 1979. 39 pp. Bituminous coal refuse, a waste product obtained from five coal preparation plants in Kentucky, was successfully sintered on a pilot-sized traveling grate to produce lightweight construction aggregate. An improved sintering grate process was used. A means is provided for utilizing a waste product while gaining an economic advantage during processing of the inherent fuel value of the refuse. A thorough laboratory investigation of the aggregate as a material for use in bituminous concrete mixes and structural lightweight portland cement concrete indicated a satisfactory aggregate for these construction materials was produced. (From author's abstract) CE918

D79-51 RETREAT MINING WITH INTEGRATED DIRT STOWING

Round, C. (Park Mill Colliery, Barnsley Area, Great Britain), The Mining Engineer 139 (219), 495-505 (Dec. 1979). The author describes the experimental work at the Park Mill Colliery in the West Yorkshire Coalfield to develop a method of stowing mining refuse in mined out areas. Some advantages of the system at that mine were reduced surface subsidence, the economical

D79-51 (continued)

mining of twin thin seams, protection for mine roadways so that they will be available for more use, and the reduction of refuse disposed on the surface. Jour

D79-52 S YORKS COLLIERY SPOIL SCHEME MOVES AHEAD

Surveyor 153 (4543), 4 (July 5, 1979). This news note reports the plan to use refuse from the South Yorkshire coalfield to create land for industry near Grimsby at the mouth of the Humber River. CE960

D79-53 GROUNDWATER CONTAMINATION PROBLEMS RESULTING FROM COAL REFUSE DISPOSAL

Schubert, J. P. (Argonne National Laboratory), in "Mine Drainage," Proceedings of the first International Mine Drainage Symposium, Denver, Colorado, G. O. Argall, Jr. and C. O. Brawner, Eds., San Francisco: Miller Freeman Publications, Inc., 1979. pp 757-780. Several instances of ground water contamination by refuse disposal piles, both in Europe and in the United States, are reviewed. Studies by Argonne National Laboratory at Staunton, Illinois are described and results of analyses of a number of ground water samples, taken before and after reclamation at the site, are tabulated, with values given for specific conductance, pH, acidity, alkalinity, sulfate, and a number of elements. Relatively good water quality in residential wells within 0.6 km of the site did not seem to be affected either by the refuse disposal or by reclamation of the refuse pile. Ground water quality observed by monitoring wells was improved in some sections of the site and not in others, depending on drainage quality and quantity from the gob. Effects of refuse drainage "decrease with distance away from the pile and approach ambient levels at a distance of less than 200 m." 628.2 M66, CE882

D79-54 CHEMICAL AND BIOLOGICAL CHARACTERIZATION OF LEACHATE FROM COAL CLEANING WASTES

Schuller, R. M., Griffin, R. A., and Suloway, J. J., in "Proceedings: Symposium on Coal Cleaning to Achieve Energy and Environmental Goals (September 1978, Hollywood, FL)," Volume II, S. E. Rogers and A. W. Lemmon, Jr., Eds., Battelle Columbus Laboratories, Interagency Energy-Environment Research and Development Program Report to U.S. EPA, Industrial Environmental Research Laboratory, Research Triangle Park, North Carolina, EPA-600/7-79-098b (April 1979). pp 898-922. A low-sulfur residue (LSR) and a high sulfur residue (HSR) from cleaning Illinois Herrin (No. 6) coal were characterized mineralogically and chemically. The chemical solubility, attenuation by soil, and toxicity of soluble constituents in a series of aqueous leachate solutions at several pHs were determined. The major chemical constituents of the solid residues were Al, Ca, Fe, K, S, and Si (greater than 1%). Ba, Cl, F, Mg, Mn, Na, Sr, Ti, and Zn were present at concentrations between 100 and 10,000 ppm. Trace metals present in the residues at concentrations between 10 and 100 ppm included As, Co, Cr, Cu, Pb, and Ni; 20 additional elements were found at concentrations less than 10 ppm. Mineralogically the coal-cleaning wastes were similar; both included illite, kaolinite, quartz, calcite, and Na-Ca feldspars. The notable exception was the large pyrite concentrations in the HSR. Seventeen chemical constituents from HSR and 20 from LSR were found to be soluble enough to exceed recommended water quality levels within the pH range studied (2.5 - 9.2) and under these laboratory test conditions. Most of these were soluble only when the pH was quite acid. Three constituents in the HSR leachates (K, NH4, and SO4) exceeded recommended water quality levels in leachates of all pHs, while no constituents in the LSR exceeded recommended levels at all pH values. The attenuation study employed the dispersed soil methodology using three widespread Illinois soils of varying character. Results showed a high degree of attenuation of the major constituents; however, elution of Mg from the soils themselves could possibly present the greatest potential for pollution from land disposal. In ninety-six-hour static bioassays conducted with young fathead minnows, full-strength acidic leachates were found to be acutely toxic and neutral leachates relatively nontoxic. However, acidic solutions of HSR, neutralized by dilution, were still found to cause mortality, suggesting a source of toxicity other than acidity. (From authors' abstract) EPA

D79-55 UTILIZATION OF FLY ASH AND COAL MINE REFUSE AS A ROAD BASE MATERIAL

Scott, R. B., Wilmoth, R. C., and Light, D. L., in "Proceedings of the 33rd Industrial Waste Conference, May 9, 10 and 11, 1978, Purdue University, Lafayette, Indiana," Ann Arbor, Michigan: Ann Arbor Science Publishers, Inc., 1979. pp 944-949. The project, carried out at the parking area at U.S. EPA's Crown Mine Drainage Control Field Site, West Virginia, is described. Although drainage from the area in which the base was constructed from refuse alone had a low pH and other pollutants, drainage from fly ash-refuse combinations was of generally acceptable quality. Quantity of drainage from all areas was low. 628.2 I323

D79-56 OTISCA PROCESS GOES ON LINE

Smith, C. D. and Keller, D. V., Jr. (Otisca Industries, Ltd.), in "Coal Conference & Expo V, Papers Presented Before the Symposium on Coal Preparation and Utilization," Louisville, Kentucky, by "Coal Age," Oct. 23-25, 1979. pp 26-34. Available, McGraw-Hill, Inc., Mining Informational Services, 1221 Ave. of the Americas, New York, NY 10020. This process uses the organic heavy liquid, trichlorofluoromethane to separate coal and refuse in a float sink system. After being separated, the coal and the refuse are drained and sent to separate evaporators where the remaining organic liquid is driven off at a temperature of about 100 F, and recycled. The refuse from this process contains enough moisture to eliminate dust, but not enough to become fluid. Therefore, the refuse can be handled as a solid and does not need to be disposed of in slurry ponds. The demonstration plant is described and the economics of the process are discussed. 662.6 C652p

D79-57 MINE WASTE DISPOSAL WITH ECONOMIC STABILITY

Smith, E. S. (1), Dworsky, B. H. (1), and Tinstman, R. A. (2) [(1) International Engineering Company, Inc. and (2) Morrison-Knudsen Company,

D79-57 (continued)

Inc.], in "Stability in Coal Mining," Proceedings of the first International Symposium, Vancouver, British Columbia, Canada, 1978, C. O. Brawner and I. P. F. Dorling, Eds., San Francisco: Miller Freeman Publications, 1979. pp 406-412. This critique of coal refuse disposal practices uses the fatal slide at Aberfan, in 1966, as an example of dumping without consideration for refuse pile stability or awareness of indicators of potential slope failure. It is suggested that design of disposal areas could emphasize economic advantage to the overall mining operation and at the same time be flexible enough to include continuing monitoring and observation which, it is noted, "is well suited to waste disposal and is already widely practiced in the mining industry." This "observational approach" would insure the instant use of planned remedial measures at the first signs of slope failure or unsafe conditions. 622 S77

D79-58 SLUDGE DEWATERING BY BELT PRESS

Soderberg, R. L. and Dorman, K. R. (U.S. Bureau of Mines, Spokane Mining Research Center), Mining Congress Journal 65 (8), 29-32 (Aug. 1979). The authors review the results of tests at Washington Irrigation and Development Co., Centralia, Washington, on dewatering coal cleaning sludge treated with flocculants, as well as results on tests on tailings from mineral mining. It is pointed out that the most favorable application of the belt press would be to dewater refuse with extremely fine particles which settle out with difficulty. Jour

D79-59 COSTS OF COAL AND ELECTRIC POWER PRODUCTION-THE IMPACT OF ENVIRONMENTAL CONTROL TECHNOLOGIES FOR COAL-CLEANING PLANTS

Thode, E. F., Williams, J. M., Wewerka, E. M., and Wagner, P., Los Alamos Scientific Laboratory, Informal Report to U.S. Department of Energy and U.S. Environmental Protection Agency, LA-8039-MS (Oct. 1979). 22 pp. Costs of 10 alternative environmental control technologies were calculated for three hypothetical and three actual cleaning plants. The cost of lime-limestone slurry coating ranged from $0.22 to $0.50 per ton of product coal. For one actual plant cleaning high-sulfur coal, the range of costs for the 10 alternatives was from $0.076 to $9.89 per ton of product coal, based on March 1978 costs. For the purpose of supplying electric utility customers, coal cleaning reduces the cost of meeting environmental standards because it is less expensive (potentially) to control the water pollution from the coal-cleaning plant than the air pollution from the utility power plant. (From authors' abstract) DOE

D79-60 ENVIRONMENTAL ASSESSMENT OF COAL CLEANING PROCESSES: MASTER TEST PLAN

Tolle, D. A., Neuendorf, D. W., and Van Voris, P., Battelle Columbus Laboratories, Interagency Energy-Environment Research and Development Program Report to U.S. EPA, Industrial Environmental Research Laboratory, Research Triangle Park, North Carolina, EPA-600/7-79-073a (Feb. 1979). 65 pp. Some of the objectives of this proposal for field testing at coal cleaning facilities are to determine the effectiveness of pollution control of leachate from

D79-60 (continued)

slurry ponds and refuse disposal areas and to monitor dust from coal refuse piles. EPA, CE848

D79-61 ENGINEERING ASPECTS OF THE 1972 BUFFALO CREEK DAM FAILURE

Volpe, R. L. (W. A. Wahler & Associates), in "Stability in Coal Mining," Proceedings of the first International Symposium, Vancouver, British Columbia, Canada, 1978, C. O. Brawner and I. P. F. Dorling, Eds., San Francisco: Miller Freeman Publications, 1979. pp 348-375. The author reviews the information obtained by W. A. Wahler & Associates in carrying out a detailed geotechnical study of the failure of Buffalo Creek dam in West Virginia. 622 S77

D79-62 FLUIDISED COMBUSTION OF COAL WASHERY WASTE

Waters, P. L., Colliery Guardian Coal International 227 (1), 50-54 (Jan. 1979). The use of coal refuse as fuel in fluidized-bed combustion (FBC) was studied in Australia as a possible solution to the problems of refuse disposal. The work done toward pilot plant design and operation, uses of FBC ash, and projected commercial applications are discussed. Jour, D441

D79-63 CONTROL OF TRACE ELEMENT LEACHING FROM COAL PREPARATION WASTES

Wewerka, E. M., Williams, J. M., Wagner, P., Wangen, L. E., and Bertino, J. P., in "Proceedings: Symposium on Coal Cleaning to Achieve Energy and Environmental Goals (September 1978, Hollywood, FL)," Volume II, S. E. Rogers and A. W. Lemmon, Jr., Eds., Battelle Columbus Laboratories, Interagency Energy-Environment Research and Development Program Report to U.S. EPA, Industrial Environmental Research Laboratory, Research Triangle Park, North Carolina, EPA-600/7-79-098b (April 1979). pp 856-874. This paper presents an overview of research at the Los Alamos Scientific Laboratory to identify methods of controlling pollution from trace or major elements in drainage from coal refuse. Laboratory work was carried out on samples of refuse from Illinois Basin coal. Methods under consideration include chemical and physical methods to immobilize or remove undesirable contaminants prior to refuse disposal, the treatment of refuse disposal sites with attenuating agents or sealants to prevent the discharge of contaminated water, and the direct treatment of refuse drainage as it emerges from the refuse disposal site. The initial results from these studies suggest that many of the techniques being considered are technically feasible for controlling trace element contamination of refuse dump drainage. (Adapted from authors' Summary) EPA

D79-64 TRACE ELEMENT CHARACTERIZATION OF COAL WASTES - THIRD ANNUAL PROGRESS REPORT, OCTOBER 1, 1977 TO SEPTEMBER 30, 1978

Wewerka, E. M., Williams, J. M., Wangen, L. E., Bertino, J. P., Wanek, P. L., Olsen, J. D., Thode, E. F., and Wagner, P., Los Alamos Scientific Laboratory, Interagency Energy-Environment Research and Development Program Report to U.S. EPA, Office of Research and Development, and U.S. Department of Energy,

D79-64 (continued)

Division of Environmental Control Technology, EPA-600/7-79-144, DoE LA-7831-PR (June 1979). 86 pp. Laboratory tests were carried out to investigate the efficacy of several methods of controlling trace element and acid water pollution from coal refuse. The methods included the use of natural sealants, such as clays, soils, calcite and cement, to isolate the disposal site from its immediate environment; co-disposal of refuse with lime, limestone or other materials to neutralize the acidity and either decrease the solubility of trace elements or act as sorbents; and treating refuse before disposal, particularly by calcining. Calcining was found to be an effective means of controlling acidity and trace element release, although the cost of removing sulfur dioxide emissions from the calcining plant was found to account for the major expense of plant operation. The various tradeoffs for these control options are discussed in terms of contaminant reduction, complexity, permanency, and cost. Initial work on leachates from low-sulfur refuse from the Appalachian region showed that aluminum, manganese, iron, nickel and copper could be elements of concern. (Adapted from authors' abstract) EPA

D79-65 UTILIZATION OF FLY ASH AND COAL MINE REFUSE AS A ROAD BASE MATERIAL

Wilmoth, R. C. and Scott, R. B., U.S. EPA, Industrial Environmental Research Laboratory, Cincinnati, Ohio, Interagency Energy-Environment Research and Development Program Report, EPA-600/7-79-122 (Aug. 1979). 48 pp. NTIS, PB-300 761/4WP The parking lot which was constructed to carry out the study was divided into three segments with a drainage monitoring system installed at each site. Chemical characteristics of the effluents discharging from the different base-course mixtures were documented. All materials were mixed and placed with standard highway construction equipment and three areas received the same surface treatment of 7.6-cm (3-in) base course and 2.5-cm (1-in) wearing course of asphaltic concrete. Area 1 was composed of a 30.5-cm (12-in) deep mixture of 75-percent coal mine refuse (CMR) and 25-percent fly ash (FA). The effluent water quality was found to be environmentally acceptable. A small intermediate area located along the edge of the pavement produced intermittent slugs of undesirably high acid and metal concentrations. The composition of the Area 2 base material was primarily the same as Area 1 except for the addition of 5 percent by weight of lime in the upper 15.2-cm (6-in) lift. Intermittent slugs of boron concentration were noted during successive winter months. Area 3 consisted solely of 38.1-cm (15-in) of coal mine refuse. The area continues to produce consistently unacceptable acid and metal concentrations in the discharge. Effluent quantities from each of the test areas were surprisingly small; i.e., approximately one liter per month from each sampling pipe. Physical structural characteristics of the road base material indicated that these waste products can be successfully used as a base or subbase material when properly compacted and/or stabilized. Monitoring of the physical and chemical characteristics of the road material began in the summer of 1973 and was discontinued in August 1977. (From authors' abstract) EPA

D79-66 RECLAMATION PRACTICES FOR COAL REFUSE AND FLY ASH DISPOSAL

Wysocki, W. (POLTEGOR, Wrocław, Poland), in "Proceedings of the Second U.S.-Polish Symposium: Coal Surface Mining and Power Production in the Face of Environmental Protection Requirements," Castle Ksiaz, Poland, by U.S. EPA and POLTEGOR, September 26-28, 1979, J. Libicki, Ed., Wroclaw, Poland, Interagency Energy-Environment Research and Development Program Report EPA-600/7-79-159 (Oct. 1979). pp 191-206. The management of coal refuse and fly ash disposal sites in Poland is described. Factors to be considered in promoting vegetation on the disposal areas are discussed. EPA

1980

D80-1 OVERVIEW OF COAL REFUSE DISPOSAL IN THE UNITED STATES

Akers, D. J., West Virginia University, Coal Research Bureau, Report No. 172 (Jan. 1980). (15 pp.) This general discussion emphasizes disposal techniques currently used to minimize pollution and describes design criteria for impoundments constructed for the disposal of refuse slurry. 662.6 W521, CE985

D80-2 TECHNICAL AND ECONOMIC EVALUATION OF UNDERGROUND DISPOSAL OF COAL MINING WASTES

Bucek, M. F., Clauser, J. K., Schad, J. A., and Chakravorti, N. K., HRB-Singer, Inc., Open file report to U.S. Bureau of Mines, Office of the Director--Division of Minerals Environmental Technology, BuMines OFR 15-80 (Jan. 1980). 349 pp. PB80-154768. This report presents the activities performed and the results achieved during a two-phase investigation of the technical and economic feasibility of disposing of coal mine refuse underground in active mines. Three coal regions that are most severely affected by coal refuse problems are southwestern Pennsylvania, southern West Virginia, and eastern Kentucky. A conceptual model mine is presented that describes the geologic conditions, mining methods, and environmental circumstances typical of each region. The model mine in the Kanawha region in southwestern West Virginia and eastern Kentucky was selected as the basis for developing alternative conceptual designs of underground disposal systems. Procedures used in selecting the regions and in modeling typical mines are described. The report presents existing methods for stowing refuse underground, three alternative conceptual designs of stowing systems that would be appropriate for the model mine, discusses technical characteristics and environmental effects relative to the various systems, and evaluates the technical and economic feasibility of the three alternative disposal system designs. Comparisons of costs among systems and with costs of surface disposal are presented. (Authors' abstract) 360.000 80-1

D80-3 IMPROVING FINES FLOTATION RECOVERY

Burdon, R. G. (1) and Mishra, S. K. (2) [(1) University of New South Wales, Australia and (2) Western Australia School of Mines], Coal Age 85 (5), 220-222, 225-227 (May 1980). Studies of electrokinetic data on fines which

D80-3 (continued)

are fed to froth flotation for coal recovery suggest that the technique of zeta potential determination can be used to select appropriate agents to enhance coal separation from minerals. Jour

D80-4 GOBS OF COAL IN RECOVERED REFUSE

Chugh, Y. P. and Heidinger, G. H. (Southern Illinois University), Coal Mining & Processing 17 (9), 84-87 (Sept. 1980). Coal quality and washability characteristics were determined on samples of refuse left from the mining of Herrin No. 6 coal in the 1940's. One refuse disposal site tested is in Franklin County and the other in Jackson County, about 10 miles apart in southern Illinois. Proximate analysis data were obtained for different size fractions. It was concluded that it would be feasible to recover coal from this refuse. Jour

D80-5 INVESTIGATION OF BURNING COAL TIPS

Surveyor 155 (4573), 12-13 (Jan. 31, 1980). Magnetic and resistivity methods of determining the extent of burning in coal refuse piles are discussed as alternatives to investigations carried out by drilling. CE955

D80-6 REDUCING RUN OF MINE DIRT

Jackson, J. B., Colliery Guardian 228 (9), 435, 438, 441 (Sept. 1980). Problems in underground disposal of mining refuse are discussed. The direct disposal of refuse at Park Mill Colliery in the Barnsley mining area, Great Britain, is described. Automatically controlled mining and precision cutting with mining machinery to reduce the amount of refuse produced are also discussed. Jour

D80-7 LOCAL LANDMARK LOSES ITS DERELICT IMAGE

Surveyor 155 (4584), 8-9 (April 17, 1980). Reclamation of refuse disposal areas at the abandoned Ifton Colliery is described. Regrading, covering of acid refuse, and revegetation were carried out in the restoration of the land, mostly to agriculture, with some improvement of woodland and the development of public foot paths. CE954

D80-8 THREE COAL MINE GOB DEGASIFICATION STUDIES USING SURFACE BOREHOLES AND A BLEEDER SYSTEM

Maksimovic, S. D. and Kissell, F. N., U.S. Bureau of Mines, RI 8459 (1980). 10 pp. This report describes three gob degasification studies conducted in the Pittsburgh coalbed. One study was conducted to determine the number of panels degasified with one large borehole. The study showed that the borehole provided degasification for three panels. Another study was conducted during the retreat of a 35-acre panel with a single-entry and a two-entry bleeder system and a large surface borehole. A major portion of methane emitted from the panel was carried away by the borehole, leaving the bleeder entries relatively free of methane. The last study was made to determine the

D80-8 (continued)

effectiveness of a timbered bleeder system. The bleeder entries successfully degasified the gob area when enough entries were available and adequate pressure was available to force the air through roof falls. (From authors' abstract) BurM

D80-9 MARTIN COUNTY PLANT HANDLES 45% REJECT

Mason, R. H., Coal Mining & Processing 17 (1), 68-69 (Jan. 1980). An hydraulic filter press, the type of equipment previously used for dewatering sewage, brewery reject, or chemical wastes, was acquired for dewatering the large volume of fine refuse slurry from the coal preparation plant. The article describes the large number of filter presses required, their operation, and problems of pumping the refuse slurry. Final disposal of the refuse is in sites where it is applied in layers and compacted. Finally, topsoil is applied to the sites and they are seeded with grasses. Jour

D80-10 THE EFFECTS OF MINERALS ON COAL BENEFICIATION PROCESSES

McMillan, B. G. (et al.), West Virginia University, Coal Research Bureau, Quarterly Reports to U.S. Department of Energy: July 1-Sept. 30, 1978, FE-2722-4 (Nov. 1978). 39 pp; Oct. 1-Dec. 31, 1978, FE-2722-5 (March 21, 1979). 34 pp; Jan. 1-March 31, 1979, FE-2722-6 (June 15, 1979). 42 pp; April 1-June 30, 1979, FE-2722-7 (Sept. 15, 1979). 32 pp; July 1-Sept. 30, 1979, FE-2722-8 (March 15, 1980). 46 pp. These reports include descriptions of the pilot scale, batch operation, coal cleaning plant set up and operated in this project, and also the results of studies characterizing raw and cleaned coals and coal refuse collected from commercial preparation plants in northern and southern West Virginia and in central Illinois. DOE

D80-11 INVESTIGATION OF THE USE OF COAL REFUSE FLY ASH COMPOSITIONS AS HIGHWAY BASE COURSE MATERIAL: STATE OF THE ART AND OPTIMUM USE AREA DETERMINATIONS

McQuade, P. V., Glogowski, P. E., Tolcser, F. P., and Anderson, R. B., GAI Consultants, Inc., Report to U.S. Department of Transportation, Federal Highway Administration, FHWA-RD-78-208 (Feb. 1980). 113 pp. NTIS, PB80-162084. This report outlines the Phase I findings from a study into the utilization of coal refuse-fly ash compositions as highway base course material. This portion of the investigation involved a comprehensive literature search into the engineering properties and field utilization of the two waste materials, including the assemblage of an annotated bibliography, and the identification of ten areas in which the use of such compositions would be optimal based on economic, environmental, and material availability considerations. (From authors' abstract) CE281

D80-12 USE OF PRESSURE FILTER TO ELIMINATE REFUSE SLURRY DISPOSAL POND

Norris, D. W. (U.S. Steel Corp., Cumberland Coal Operations), Mining Congress Journal 66 (8), 49-50, 52 (Aug. 1980). The processes for dewatering and disposal of fine refuse at U.S. Steel's Cumberland Coal Operation, in Greene

D80-12 (continued)

County, Pennsylvania, are described. The dewatered filter cake is added to the coarse refuse and disposed of in a landfill. Problems with the filter cloth, refuse handling equipment, and with solids and ash characteristics of the process streams ahead of the dewatering equipment are discussed. Jour

D80-13 PROTOTYPE ANTHRACITE CULM COMBUSTION BOILER/HEATER UNIT, CITY OF WILKES-BARRE, PENNSYLVANIA

Pope, Evans and Robbins Incorporated, Foster Wheeler Boiler Corporation, and Wilkes-Barre, Pennsylvania, Quarterly Technical Reports to U.S. Department of Energy: Report No. 1, Oct. 1-Dec. 31, 1978, FE-2652-T1 (undated.) 21 pp. Report No. 2, Jan. 1-March 31, 1979, FE-2652-T2 (undated.) 47 pp. Report No. 4, July 1-Sept. 30, 1979, DOE/FE-2652 (Jan. 1980). 38 pp. A program was initiated in October 1978 to design, construct and evaluate a 100,000 pph atmospheric fluidized bed steam generator burning anthracite culm with the addition of fresh anthracite, if required. The unit is to demonstrate the technical, economical and environmental feasibility of producing 150 psig saturated steam for district heating in downtown Wilkes-Barre. Refuse source, evaluation, handling, and delivery are described in Report No. 1. In Report No. 2, initial hot model testing is described and it is also noted that the source of refuse previously decided upon was no longer available. Preliminary design and flow diagrams of the plant are shown. Report No. 4 gives further design plans and information on the completion of the hot model testing on a new source of coal refuse. (Adapted from abstracts of the Reports) DOE

D80-14 NEW USES FOR COAL REFUSE AS CONSTRUCTION MATERIALS

Rose, J. G. (University of Kentucky), Mining Congress Journal 66 (9), 38-43 (Sept. 1980). Also presented at American Mining Congress, Mining Convention, Los Angeles, California, Sept. 23-26, 1979. Session Papers, Set No. 7. 22 pp. The author summarizes the extensive project at the University of Kentucky, Institute for Mining and Minerals Research to characterize coal refuse, define the geotechnical properties of refuse, and explore uses for refuse, particularly as building materials. Jour

D80-15 U.K.-DEVELOPED AUTOMATIC METHOD OF SOIL STABILISATION

Mining Magazine 142 (3) 283, 285 (March 1980). Treatment of refuse slurry at several collieries in the South Wales mining area includes automatic addition of high molecular weight polyelectrolyte flocculants for thickening, and then automatic addition of cement to make a low grade concrete. CE950

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effluents. The program also found several approaches for the enhancement of pyrite removal during oil agglomeration of freshly ground coal. Coal recoveries of 90 percent or greater were realized from sediments from fresh, aged and weathered cleaning plant (i.e., slurry pond) wastes. The total sulfur and ash concentrations of the coal recovered from wastes were lower than the coal being shipped from the cleaning plant. The rejected mineral matter was essentially free of coal, exhibited improved settling characteristics and appeared to be suitable for land disposal and may have potential as a raw material. Recovered coal costs based on hypothetical flow diagram based on results from the study were estimated at $14 per ton. Various oils were found to be effective including coal derived liquids. For the first time using the oil agglomeration technique, pyrite removal from freshly ground coal was enhanced by mild chemical treatment and the use of a dispersing agent to levels attainable by float sink analysis. (From authors' abstract) EPA

D79-41 MICROBIAL ECOLOGY STUDIES AT TWO COAL MINE REFUSE SITES IN ILLINOIS

Miller, R. M. and Cameron, R. E., Argonne National Laboratory, Land Reclamation Program, Report to U.S. Department of Energy, ANL/LRP-3 (July 1978, Reprinted Feb. 1979). 44 pp. An investigation was made of the microflora associated with coal refuse at two abandoned mines in the midwestern United States. One mine was near Staunton, Macoupin County, with drainage into Cahokia Creek, and the other site was at Little Dog Mine approximately 8 miles north of Staunton. Information was gathered for both the edaphic and the biotic composition of the refuse material. Emphasis was placed on heterotrophic and autotrophic components as to numbers, kinds, and physiological groups. The presence of chemolithotrophs was also investigated. The relationship between abiotic and biotic components in regard to distribution of bacteria, fungi, and algae is discussed. Information presented in this report will be utilized in assessing trends and changes in microbial numbers and composition related to manipulations of the edaphic and biotic ecosystem components associated with reclamation of the refuse piles. (Authors' abstract adapted) DOE

D79-42 MODEL STATE PROGRAM FOR CONTROL AND PREVENTION OF WATER POLLUTION FROM COAL PREPARATION PLANTS AND REFUSE DISPOSAL AREAS

Ohio River Valley Water Sanitation Commission, Cincinnati, Ohio, ORS/MS-79/02 (June 1979). 18 pp. NTIS, PB80-10694. This is the third part of a report to describe a model state program for control and prevention of water pollution from underground and surface mines, and coal preparation and refuse disposal areas. The report describes a program to oversee site selection, preconstruction planning, operation, and post-operation, control. Also delineated are the legal authority necessary for conducting an effective control program and the professional expertise required to implement such a program. (Abstract of the report adapted) ORSANCO

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APPENDIX A

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D79-41 MICROBIAL ECOLOGY STUDIES AT TWO COAL MINE REFUSE SITES IN ILLINOIS

Miller, R. M. and Cameron, R. E., Argonne National Laboratory, Land Reclamation Program, Report to U.S. Department of Energy, ANL/LRP-3 (July 1978, Reprinted Feb. 1979). 44 pp. An investigation was made of the microflora associated with coal refuse at two abandoned mines in the midwestern United States. One mine was near Staunton, Macoupin County, with drainage into Cahokia Creek, and the other site was at Little Dog Mine approximately 8 miles north of Staunton. Information was gathered for both the edaphic and the biotic composition of the refuse material. Emphasis was placed on heterotrophic and autotrophic components as to numbers, kinds, and physiological groups. The presence of chemolithotrophs was also investigated. The relationship between abiotic and biotic components in regard to distribution of bacteria, fungi, and algae is discussed. Information presented in this report will be utilized in assessing trends and changes in microbial numbers and composition related to manipulations of the edaphic and biotic ecosystem components associated with reclamation of the refuse piles. (Authors' abstract adapted) DOE

D79-42 MODEL STATE PROGRAM FOR CONTROL AND PREVENTION OF WATER POLLUTION FROM COAL PREPARATION PLANTS AND REFUSE DISPOSAL AREAS

Ohio River Valley Water Sanitation Commission, Cincinnati, Ohio, ORS/MS-79/02 (June 1979). 18 pp. NTIS, PB80-10694. This is the third part of a report to describe a model state program for control and prevention of water pollution from underground and surface mines, and coal preparation and refuse disposal areas. The report describes a program to oversee site selection, pre-construction planning, operation, and post-operation, control. Also delineated are the legal authority necessary for conducting an effective control program and the professional expertise required to implement such a program. (Abstract of the report adapted) ORSANCO